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of Transportation
National Highway
Traffic Safety
Administration

Data for Validation of Crash Victim Simulator

COMPLETED
792

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16. Abstract

Replicate 30 MPH sled tests of a 50th percentile male anthropomorphic dummy restrained by a pre-inflated air bag and a three-point belt restraint were performed to provide data for validating mathematical simulation models of a crash victim. Special instrumentation of the dummy included triaxial accelerometers on the lower arms and 64 photographic targets attached to the dummy to permit measurement of segment motions from analysis of films from six high-speed cameras used to photograph the tests. Normal and tangential loads generated by contact of the dummy with the seat, toeboard, knee bolster and air bag reaction panel were also measured.

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METRIC CONVERSION FACTORS

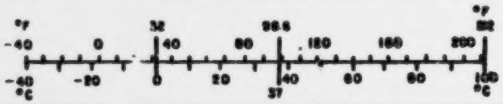
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

inches
cm
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

PREFACE

This document is the final report of the research program entitled "Data For Validation of Crash Victim Simulator" performed by the Calspan Corporation Advanced Technology Center for the National Highway Traffic Safety Administration (NHTSA) under Contract No. DOT-HS-7-01660. High-speed movie films of the sled tests described herein provided to the NHTSA constitute a supplement to this final report.

The author wishes to express his appreciation for the contributions of the following Calspan personnel: Mr. Seridan Smith who performed the detail design of test hardware, Mr. Joseph Vertino who was responsible for construction of the sled buck, and Mr. Kenneth Naab for his assistance in the performance of the sled tests.

The NHTSA Contract Technical Manager for this program was Dr. Lee J. Ovenshire.

The opinions, findings, and conclusions expressed in this publication are those of the author and not necessarily those of the National Highway Traffic Safety Administration.

This report has been reviewed and approved by:

Anthony L. Russo

Anthony L. Russo, Head
Transportation Research Department
Calspan Advanced Technology Center

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1. INTRODUCTION

For more than a decade the Calspan Advanced Technology Center has been engaged in the formulation, development, and checkout of a large digital computer simulation program for predicting the three-dimensional dynamic responses of motor vehicle crash victims (References 1-5). In the research project entitled "Validation of the Crash Victim Simulator" performed by Calspan for the National Highway Traffic Safety Administration (Reference 6), part of the effort involved modeling impact sled tests of a restrained dummy subjected to realistic crash environments in order that the model predictive capability might be assessed based on comparisons of the simulated and experimentally measured responses.

This report describes the methodology and results of the sled test program carried out to obtain the comprehensive experimental data needed to support the aforementioned crash victim simulator (CVS) validation study. The tests were performed using the Calspan HYGE accelerator sled test facility and simulated 30 MPH frontal vehicle impacts in which a 50th percentile male anthropomorphic dummy was restrained by a pre-inflated air bag and by a 3-point lap and shoulder belt restraint system. The test configurations were specially designed to provide measurements of dummy contact forces with the simulated vehicle interior and to permit the three-dimensional motions of the dummy segments to be determined by photometric analysis of film from up to six onboard high-speed cameras. Three sled runs of each restraint configuration were performed to assure the reliability of the data based on the repeatability of the responses recorded in the replicate tests.

2. DESCRIPTION OF TEST SETUPS

2.1 Sled Buck

The sled buck was basically a box frame made of steel angles and channels which provided the supporting structure for several instrumented contact panels positioned to represent the interior geometry and profile of a vehicle passenger compartment. The contact panels included a seat, toeboard, knee bolster, and an airbag reaction panel representing the windshield and upper dash. The size and location of these panels in the sled buck coordinate system (for which the origin is the left rear corner of the buck frame at the floor level) is shown in Figure 1. Also shown in the figure are the locations of the belt anchorages for the tests of the belt restraint configuration.

The contact panels were separate subassemblies consisting of a reinforced aluminum plate supported by load cells mounted on a base plate to facilitate calibration and maintenance of load cell alignment as well as to allow ease of installation and removal from the buck structural framework.* Each panel was instrumented with four load cells -- three in a triangular pattern for measurement of normal forces and the other positioned to measure the tangential force components in the longitudinal vertical plane. Clevises and spherical rod ends were used to connect the load cells to the panel which provided the flexibility needed to decouple off-axis force components and avoid contamination of the measurements in the direction of the sensitive axis of the transducers. Similar hardware was used to obtain the lateral and rotational (about the normal axis) motion constraints needed for complete stabilization of the panels.

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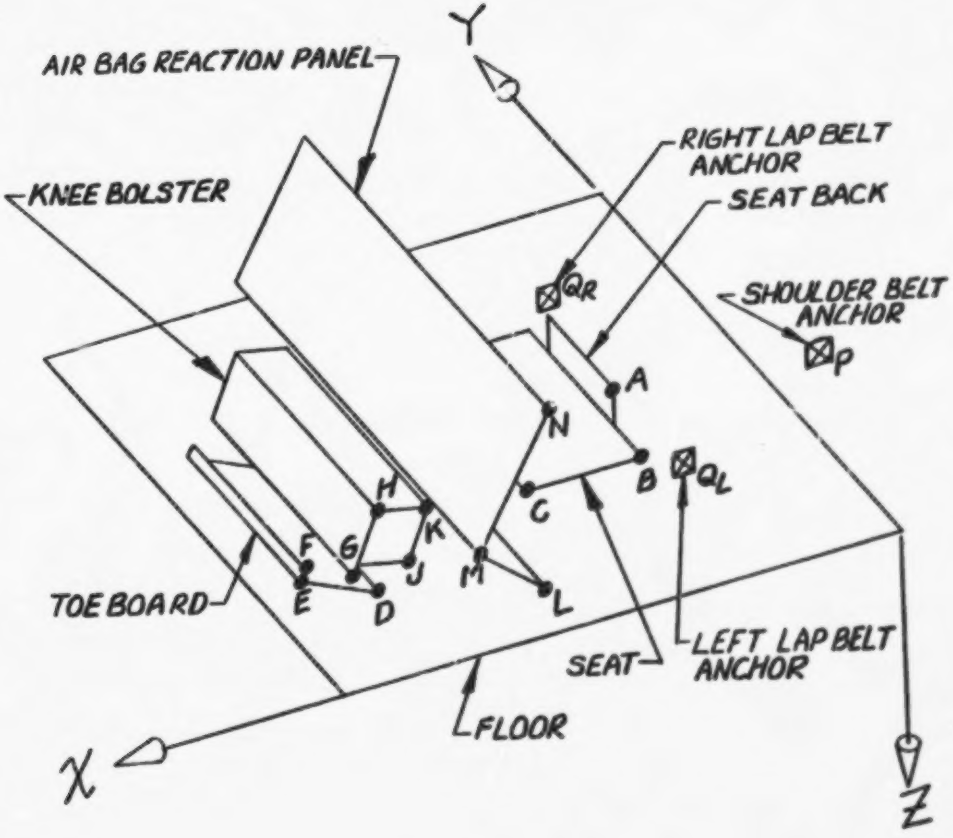
*The knee bolster and air bag reaction panels and associated supporting structure were removed for the belt restraint tests to permit headon camera coverage.


Y
AIR BAG REACTION PANEL
RIGHT LAP BELT ANCHOR
SEAT BACK
KNEE BOLSTER
Q_R
SHOULDER BELT ANCHOR
P
A
N
B
Q_L
C
H
K
F
G
J
M
E
D
L
TOE BOARD
SEAT
LEFT LAP BELT ANCHOR
FLOOR
X
Z

POINT	COORDINATES ~ IN. X	Y	Z
A	19 1/2	18 15/16	-11 5/8
B	19 5/8	15 9/16	-6 7/8
C	37 1/16	15 7/16	-6 1/8
D	54 3/4	15 1/2	0
E	63 1/8	15 1/2	-7
F	61 15/16	15 1/2	-8 5/8
G	57 1/4	13 1/4	-12 1/2
H	53 1/16	13 5/16	-21
J	51 1/8	14 1/4	-11 1/8
K	47 11/16	14 1/4	-18 3/8
L	50 3/16	8 11/16	-22 1/2
M	58 1/4	8 3/4	-30 5/8
N	39 7/8	8 7/16	-48 11/16
P	-2	12 1/2	-42 3/8
Q_L	11 1/2	15 11/16	-1
Q_R	11 7/16	32 3/16	-1

CONTACT PANEL	WIDTH (IN.)
SEAT	16 1/2
SEAT BACK	10
TOE BOARD	16
KNEE BOLSTER	21
A/B REACT. PANEL	30

Figure 1 LOCATIONS OF CONTACT PANELS & BELT ANCHORAGES IN SLED BUCK

Prior to installation on the sled, each contact panel subassembly was subjected to static calibration tests and checks for cross talk in the normal and tangential force measurements. Normal loads in excess of 1100 lbs. were applied incrementally and both with and without a simultaneous tangential load of nearly 500 lbs. These tests indicated satisfactory isolation from any cross-axis force components. Some additional tests in which the point of normal load application was varied on the surface of the panel also showed that the sum of the output from the three load cells measuring forces in that direction was unaffected.

A small aluminum plate attached to the rear of the seat was used as a seatback to aid in positioning the dummy on the seat and to help retain the dummy during rebound from the restraints and braking of the sled. A small seatback was necessary to avoid obscuring the dummy from the view of cameras as well as to minimize the possibility of damaging brackets used to attach photographic targets on the rear of the dummy during rebound into the seat. Excessive rearward motion of the dummy upper torso was prevented by a cable which was wrapped around the chest with the ends extending forward on either side of the dummy and fastened to the buck structure. Since the cable became slack as the dummy moved forward in the buck, it did not affect the dummy motion into the restraints.

The panel for reacting the air bag loads consisted of two orthogonal plane surfaces designed as an integral structure with four load cells for measurement of the applied forces. In this report, the normal and tangential force directions are with reference to the larger plane representing the windshield. It should be noted that the tangential forces were relatively large due to the bag support provided by the dashboard portion of the reaction panel.

The positive directions of the normal and tangential forces on each contact panel are shown in Figure 2.

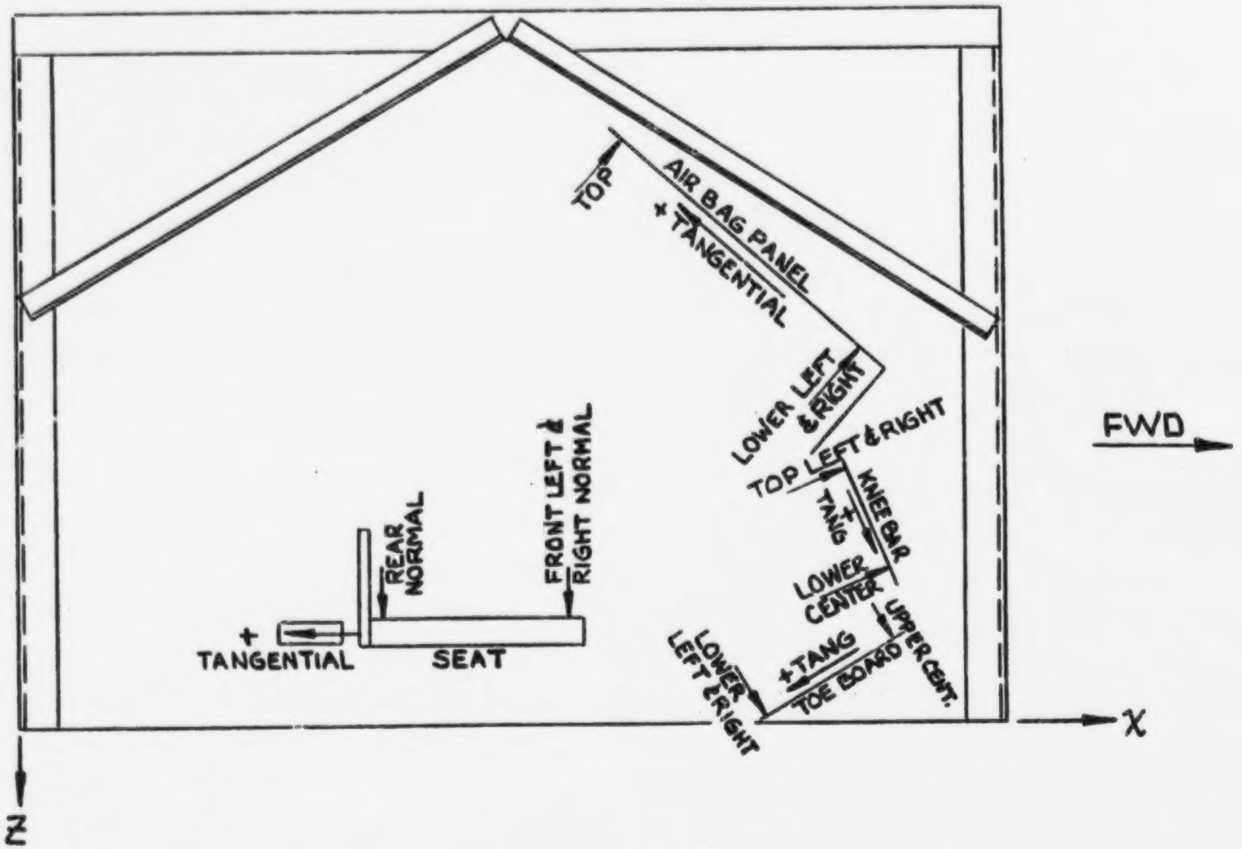

TOP
AIR BAG PANEL
+ TANGENTIAL
LOWER LEFT & RIGHT
TOP LEFT & RIGHT
KNEE BAR
+ TANG
LOWER CENTER
UPPER CENT.
+ TANG
TOE BOARD
LOWER LEFT & RIGHT
REAR NORMAL
FRONT LEFT & RIGHT NORMAL
+ TANGENTIAL
SEAT
FWD
X
Z

Figure 2 POSITIVE DIRECTIONS OF NORMAL AND TANGENTIAL FORCES ON CONTACT PANELS

2.2 Air Bag Restraint Configuration

The setup for the pre-inflated air bag restraint tests, shown in the photograph of Figure 3, was similar to the configuration successfully used in previous investigations of the repeatability of dummy responses in replicate sled tests (e.g., Reference 7). The bag was fabricated from 5-ounce coated nylon fabric in the shape of a cylinder 28 inches in diameter and 30 inches long. A 3-inch diameter vent hole was provided at each end and a lightweight weather balloon liner made the bag airtight. Upon impact of the dummy against the bag, the liner extruded through the vents and ruptured, allowing the air to escape and thereby reducing the rebound of the dummy from the bag. Bag pressure was measured by a sensor connected to a flexible tube inserted through neck of the balloon liner.

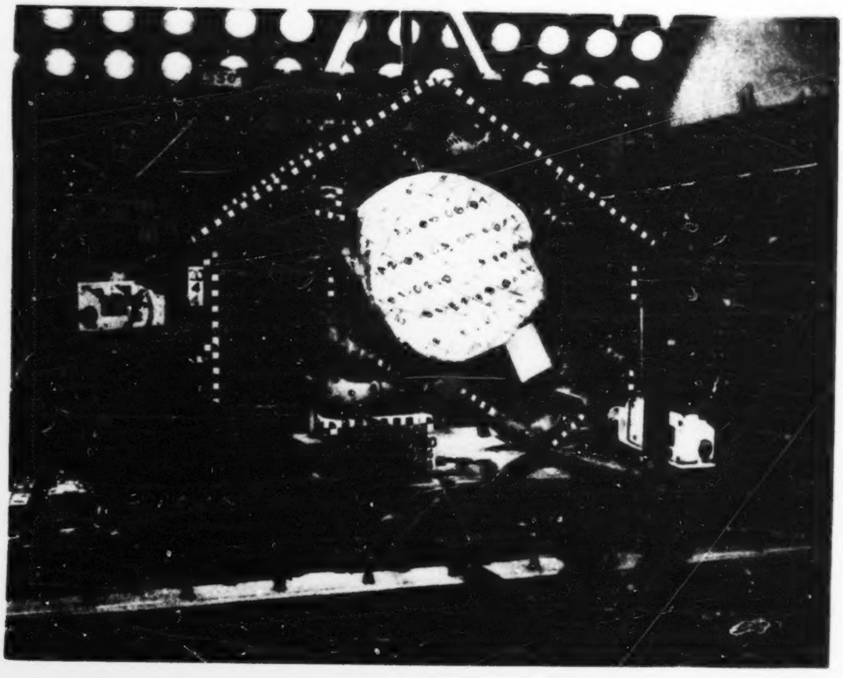


Figure 3 PRE-INFLATED AIR BAG TEST CONFIGURATION

To aid photometric analysis of the bag shape during penetration by the dummy, the surface of the bag was marked with grid lines spaced 3 inches apart. The air bag flat pattern grid lines and zone markings are illustrated in Figure 4.

The knee bolster used to control the motion of the dummy lower torso was provided with a deformable, energy-absorbing pad for the contact by the knees and lower legs. The pad consisted of three 2-inch thick layers of rigid foam material bonded together and attached to the aluminum backup plate supported by the load cells. The density of the outer layer (Styro-Foam "FR") was 1.8 lb/ft^3 and the density of each of the two inner layers (Styro-Foam "HD-300") was 3 lb/ft^3.

2.3 Belt Restraint Configuration

Photographs showing the setup for the belt restraint tests are presented in Figure 5. For these tests, the air bag and knee bolster contact panels and associated supporting structures were removed from the sled buck which permitted use of an additional high speed camera to photograph the dummy headon. As may be seen in Figure 5, the upper torso belt crossed over the left shoulder of the dummy like that for an occupant in the driver seat position.

A standard 3-point belt system having the lower end of the shoulder belt and the lap belt independently attached to the buckle latch plate (i.e., a non-slip point) was employed for the tests. Each belt was equipped with a slack adjuster and load limiting devices were provided at each of the three anchorages to the sled buck.

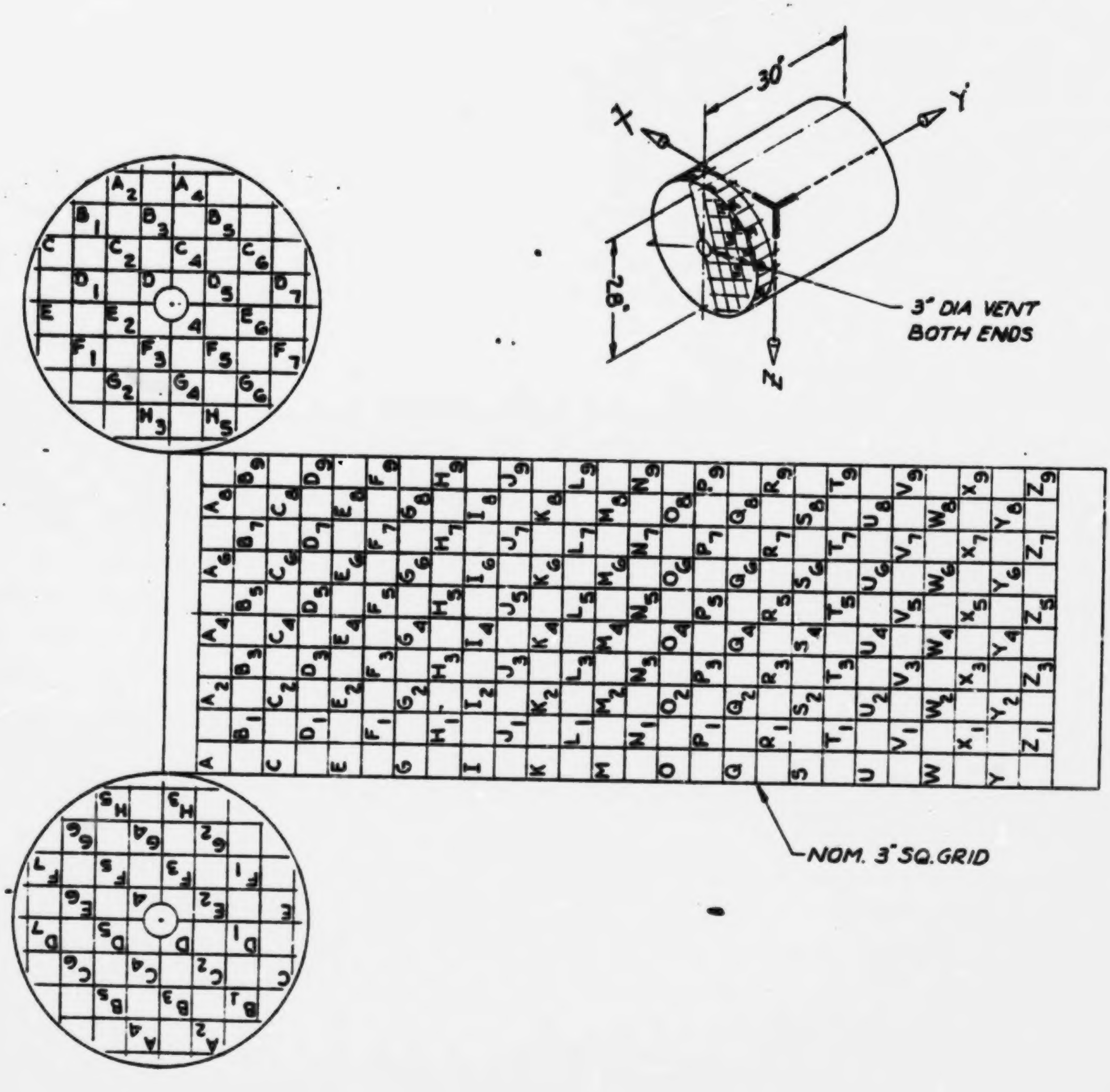

30"
X
Y
Z
28"
3" DIA VENT
BOTH ENDS
NOM. 3" SQ.GRID

Figure 4 CYLINDRICAL AIR BAG FLAT PATTERN GRID MARKING

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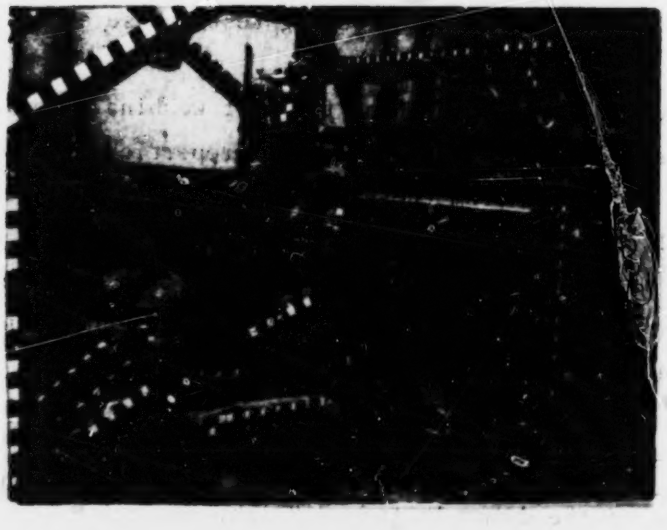

Figure 5 SETUP FOR 3-POINT BELT RESTRAINT TESTS

Data from earlier 30 MPH belt restraint sled tests with 50th percentile male dummies (e.g., References 7, 8) were reviewed to establish the limit load performance requirements. The data indicated that the maximum loads developed in 3-point belt restraint systems without force limiting were typically about 2000 lb. at the upper end of the shoulder belt and one end of the lap belt, and 3000 lb. at the common anchor for the belts. Force levels between 60 and 75 percent of these values were selected as the performance requirement for the design of the load limiters to ensure they would function to dissipate energy. The load limit devices were of a type investigated during Phase II of the Calspan Research Safety Vehicle (RSV) program and operated by deforming a rod pulled through a series of rollers. Data generated in tests performed in the RSV program were used to aid selection of combinations of rod materials and roller offsets that would produce the desired limit loads. For the 1200 to 1500 lb. load range desired for the upper torso belt and one end (left) of the lap belt, a 0.25 inch diameter copper-coated welding rod and roller offset of 0.7 inches were used. The design limit load of 2000 lb. at the common[*] anchor for the belts on the right side of the dummy was obtained by using a 0.25 inch diameter 1018 cold rolled steel rod and a 1 inch offset for the rollers. Satisfactory operations of the load limiters was verified by results from static and dynamic loading tests of several assemblies.

Static and dynamic tests of the belt webbing were also performed to obtain measurements of the force-deflection properties for use in simulating the sled tests. The data from these tests of the webbing[**] are shown in Figure 6. In the static test, the belt was slowly loaded by a Southwark-Emery tensile testing machine up to 2000 lb. and then unloaded. The strain was computed from manual measurements of the distance between two reference marks on the webbing that were initially 9 inches apart. As noted in the

---

[*] The common anchor for the lower end of the shoulder belt and the lap belt on the right side of the dummy is termed "right lap belt" herein.

[**] Tests performed under Contract DOT-HS-6-01300 (Reference 6) are included in this report for completeness.

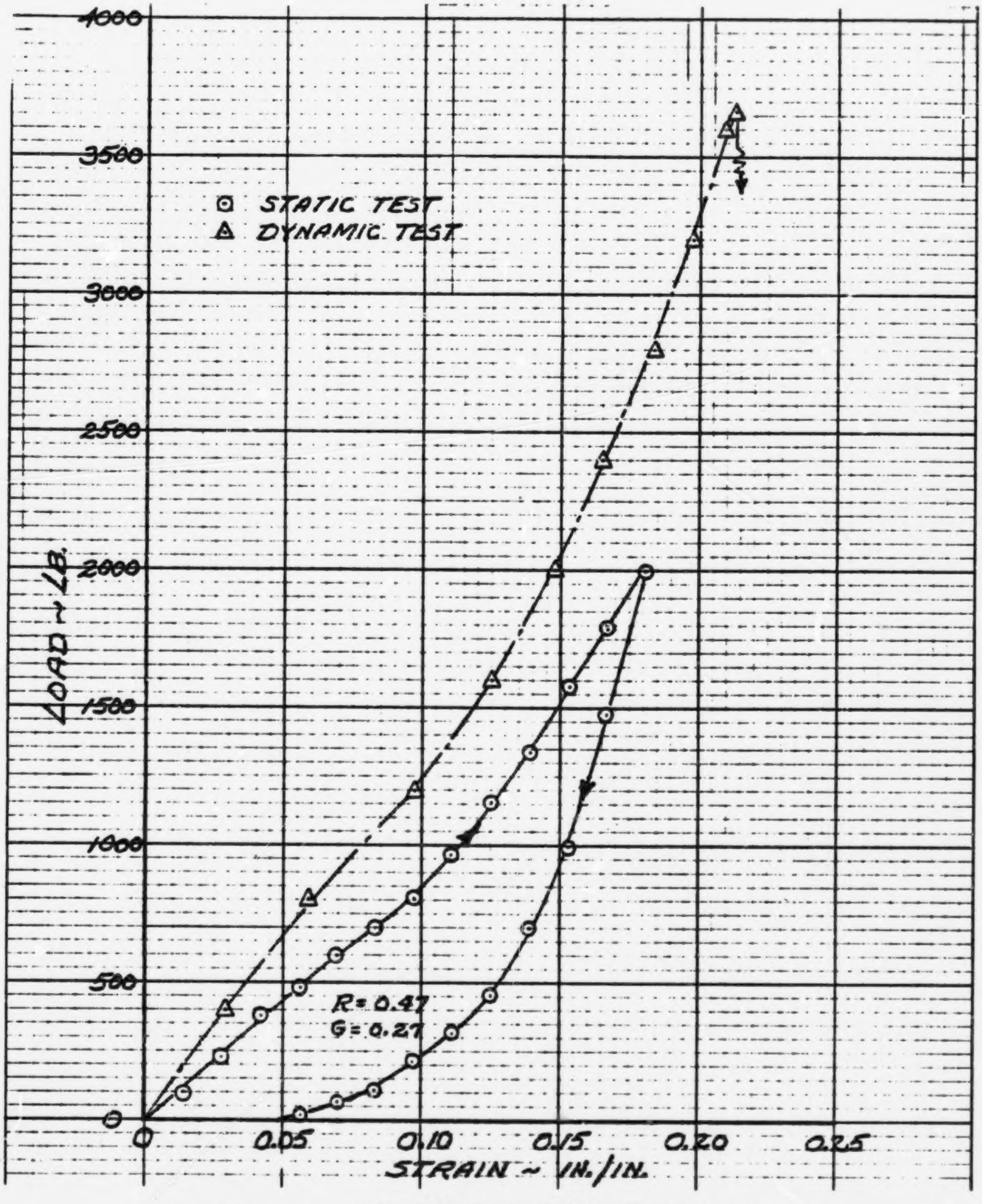

Figure 6 BELT WEBBING STRETCH CHARACTERISTICS FOR STATIC & DYNAMIC LOADING

Figure, R (energy recovery) and G (set) factors of 0.47 and 0.27, respectively, are indicated by the hysteresis loop of the load/unload cycle of the static test.

Loading of the webbing in the dynamic test was accomplished by releasing a 2000 lb. drop weight that initially was mostly supported by a crane, but which also applied a small pre-tension load to the belt so the belt was taut. In this way, when the weight was suddenly released from the crane it immediately began to load and stretch the belt. The load on the webbing was measured by a load cell and the elongation of the belt was measured by a linear potentiometer attached to two aluminum angles securely stitched to the webbing at an initial separation distance of 20 inches. The test was terminated when the stitching in the belt loop attachment for the buckle latch plate failed at a load of 3670 lb. at approximately 250 milliseconds. The time history record of the load indicates that the maximum rate of loading in the test was approximately 30,000 lb/sec. The plots of Figure 6 show that, on the average, the stiffness of the webbing is about 50 percent greater for dynamically applied belt loads compared to static loading.

A sketch showing the general arrangement and dimensions of various elements of the belt restraint system are measured in each of the three replicate sled runs is presented in Figure 7.

Restraint system instrumentation consisted of load cells that measured tension in the belt webbing near each anchor and string potentiometers to measure elongations of the lap and shoulder belts and the stroke of each load limiter device. Photographs of the instrumentation installations in the sled buck are given in Figure 8. The apparatus for measurement of belt elongations included a light cable contained within a flexible sheath that was positioned along the length of the belt and held in place by stitches. The cable, secured to the webbing near one end of the belt, was wound on a seat belt retractor mounted on the load limiter at the other end of the belt (load limiters at the left lap and upper torso belt anchor points for the lap and

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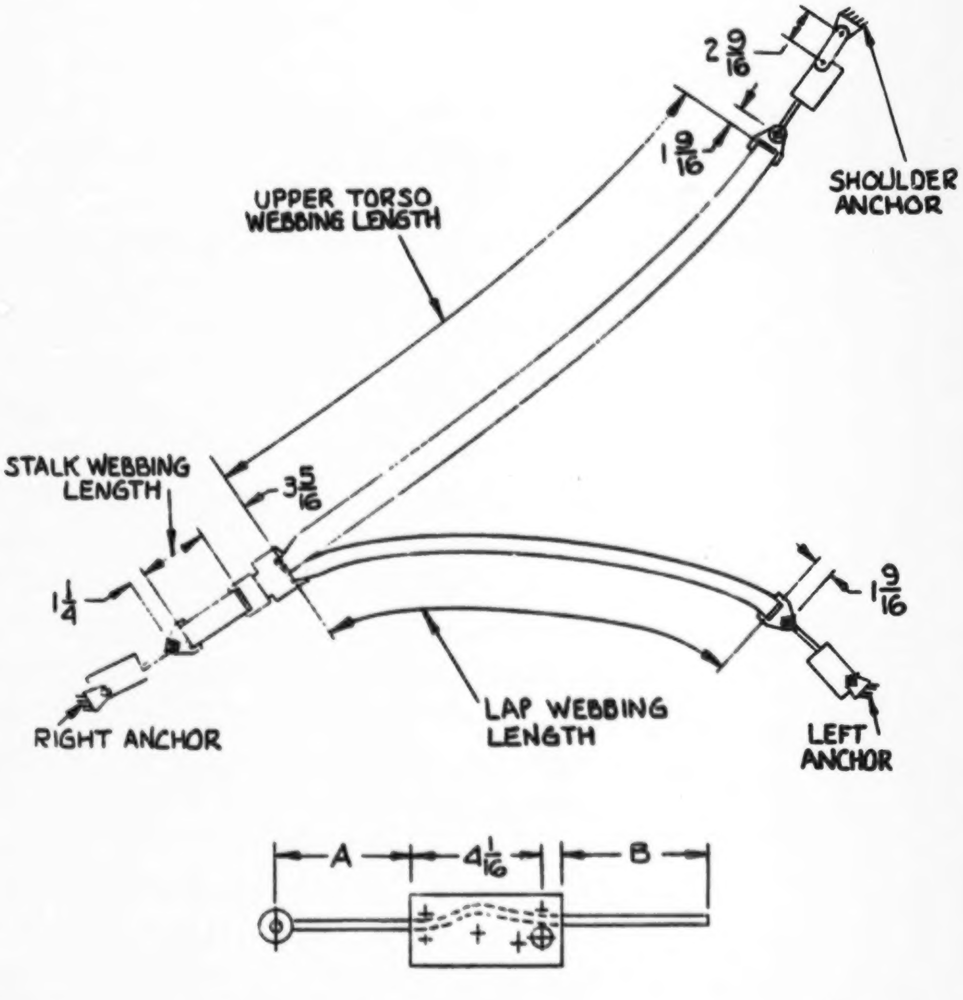

2 9/16
1 9/16
SHOULDER ANCHOR
UPPER TORSO WEBBING LENGTH
STALK WEBBING LENGTH
3 5/16
1 1/4
1 9/16
RIGHT ANCHOR
LAP WEBBING LENGTH
LEFT ANCHOR
A
4 1/16
B

TEST NO.	WEBBING LENGTH (INCHES)			LOAD LIMITER LENGTH (INCHES)																	
				LEFT LAP						RIGHT LAP						SHOULDER					
				A			B			A			B			A			B		
	UPPER TORSO	LAP	STALK	PRE TEST	POST TEST	STROKE	PRE TEST	POST TEST	STROKE	PRE TEST	POST TEST	STROKE	PRE TEST	POST TEST	STROKE	PRE TEST	POST TEST	STROKE	PRE TEST	POST TEST	STROKE
2049	35.38	20.13	11.50	4.13	5.75	1.62	8.75	7.00	1.75	5.44	6.75	1.31	7.69	6.31	1.38	5.06	6.38	1.32	8.19	6.88	1.31
2050	39.00	21.25	11.63	4.44	6.56	2.12	8.12	6.19	1.93	3.44	4.88	1.44	9.06	7.81	1.25	3.81	5.06	1.25	8.81	7.81	1.00
2051	39.00	19.75	11.63	4.75	7.38	2.63	8.44	5.94	2.50	4.50	5.56	1.06	8.44	7.44	1.00	3.50	3.56	0.06	9.44	9.31	0.13

Figure 7   ARRANGEMENT AND DIMENSIONS OF BELT RESTRAINT SYSTEM ELEMENTS

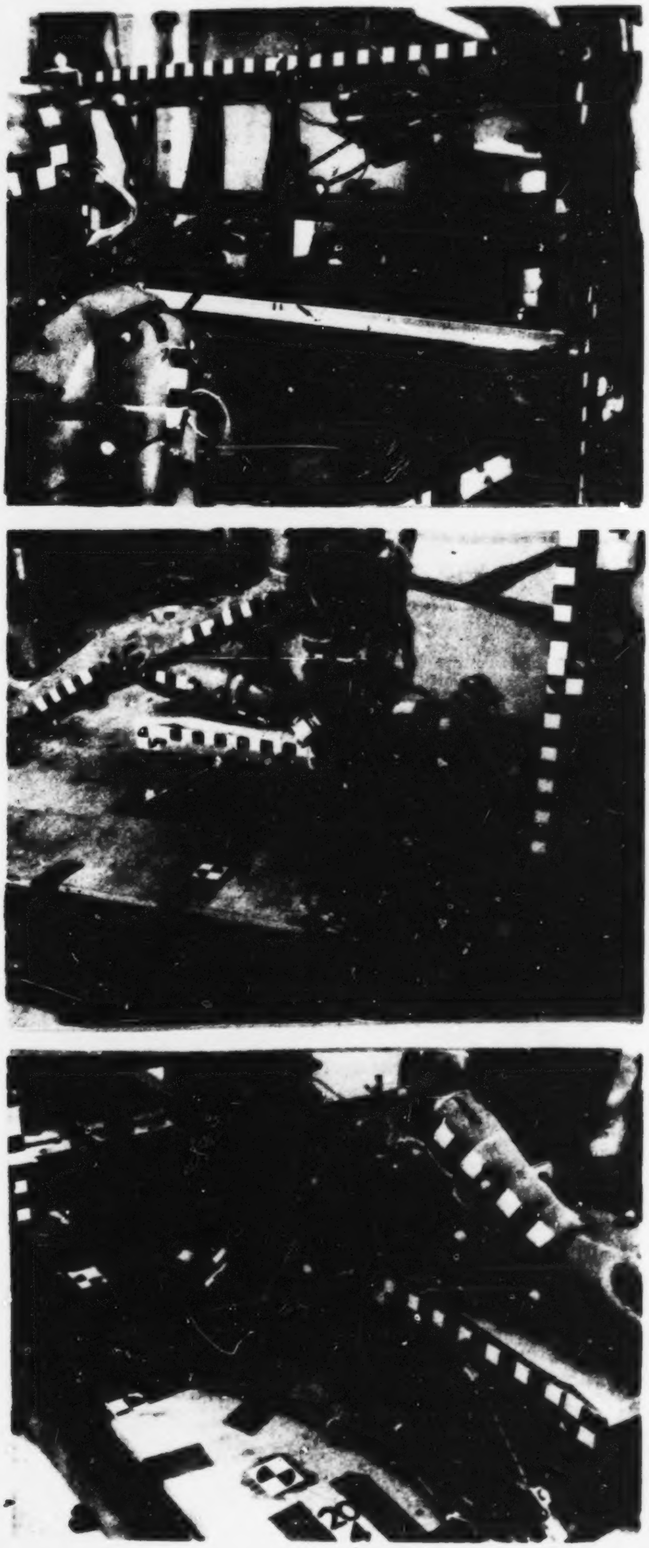


Figure 8 BELT RESTRAINT SYSTEM MEASUREMENT APPARATUS

shoulder belts, respectively). A potentiometer connected to the retractor spool shaft provided an electrical signal proportional to the length of the cable payed out due to stretching of the belt and strcking of the load limiter. Since the load limiter stroke was separately measured with another potentiometer, the difference between the two measurements is the belt elongation.

A number of 0.5 inch diameter lucite hemispheres of various colors were attached to the belts at 3-inch intervals to serve as photographic targets and are visible in the photographs of Figures 5 and 8.

2.4 Anthropomorphic Test Dummy and Instrumentation

All of the sled tests were performed using a new 50th percentile male anthropomorphic test dummy designed to meet FMVSS 208 Part 572 specifications. The dummy is identified as Alderson Research Laboratories Model No. ATD 30022, Serial No. 749.

The dummy was instrumented with 21 accelerometers for measurements of triaxial accelerations of the head, chest, pelvis, and the left and right lower arm segments, and with femur load·cells to measure loads arising from contact of the legs with the knee bolster in the tests of the pre-inflated air bag configuration. Nine miniature linear accelerometers (Endevco Model 2264) were installed in the head cavity to provide data that would permit calculation of angular accelerations by the "nine accelerometer method" described in Reference 9. The accelerometers and their locations in the head of the dummy are identified in Figure 9. Three similar miniature accelerometers were mounted on a small aluminum bracket that was attached to the posterior side of the rectangular skeletal structure of each forearm approximately 6 inches below the elbow pin joint. The coordinates of the accelerometer seisonic masses in a local reference system defined for the forearms are given in Figure 10.

ACCELEROMETER	COORDINATES* OF SEISMIC MASS (INCHES)		
	X	Y	Z
X_0	-0.37	-0.50	-1.20
X_1	-0.37	0.91	-1.20
X_3	-0.37	-0.50	-2.70
Y_0	-0.03	-0.78	-1.31
Y_2	1.47	-0.78	-1.31
Y_3	-0.03	-0.78	-2.59
Z_0	-0.03	-0.50	-0.86
Z_1	-0.03	0.91	-0.86
Z_2	1.47	-0.50	-0.86

*COORDINATE REFERENCE ORIGIN IS POINT OF INTERSECTION OF NECK CENTERLINE WITH BOTTOM SURFACE OF SKULL PLATE.

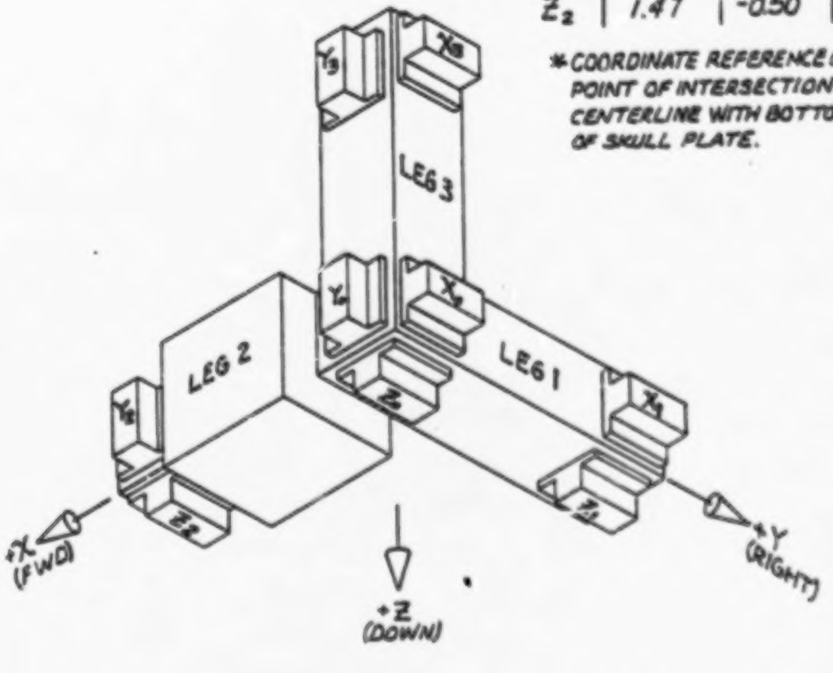
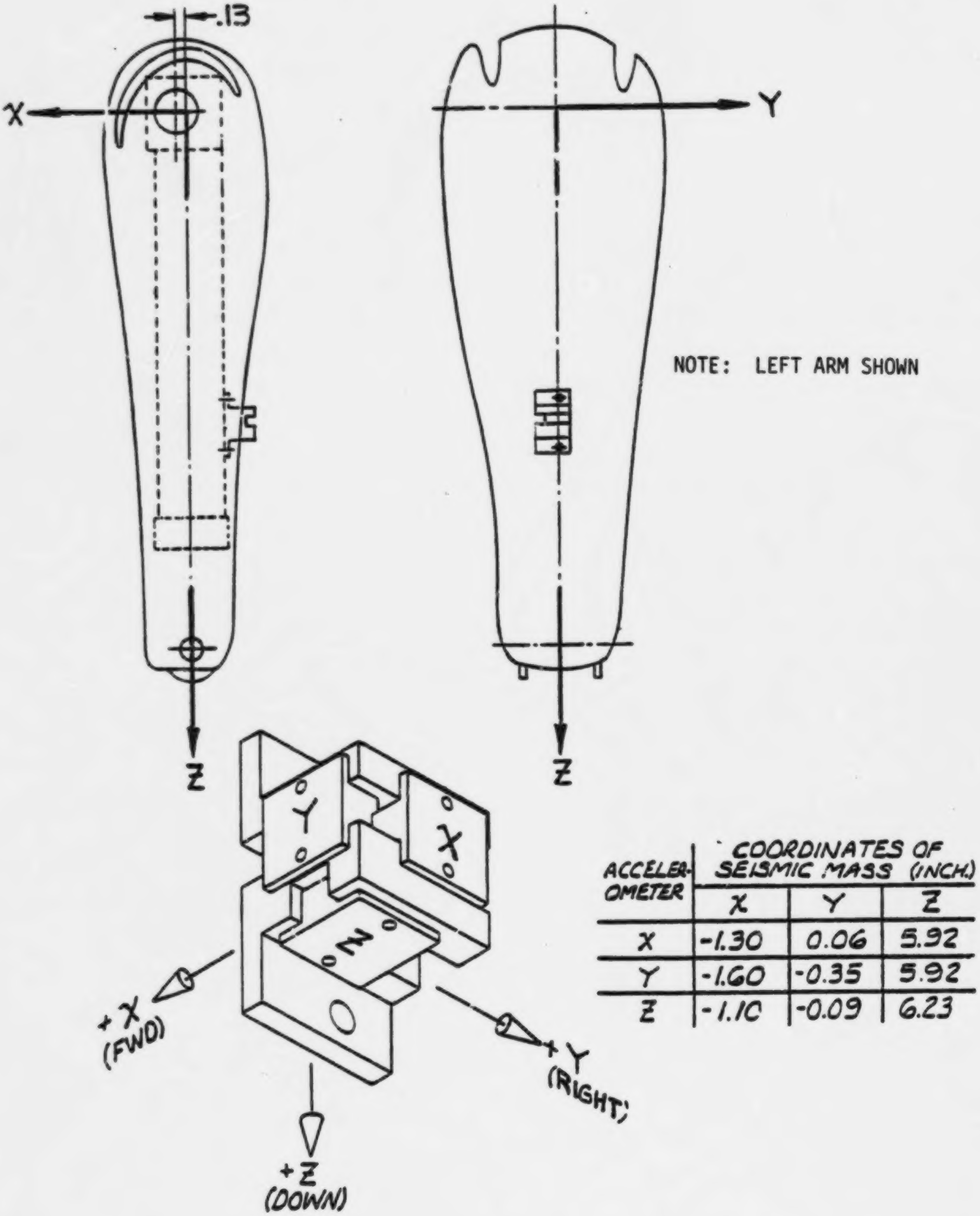

Y_3
X_3
LEG 3
Y_0
X_0
LEG 2
LEG 1
Y_2
Z_0
X_1
Z_2
Z_1
+X (FWD)
+Z (DOWN)
+Y (RIGHT)

Figure 9 HEAD ACCELEROMETER LOCATIONS


.13
X
Y
Z
Z
NOTE: LEFT ARM SHOWN
Y
X
Z
+X
(FWD)
+Y
(RIGHT)
+Z
(DOWN)

ACCELEROMETER	COORDINATES OF SEISMIC MASS (INCH.)		
	X	Y	Z
X	-1.30	0.06	5.92
Y	-1.60	-0.35	5.92
Z	-1.10	-0.09	6.23

Figure 10 LOCATIONS OF ACCELEROMETERS ON LOWER ARMS

A total of 64 colored lucite balls (0.75 in. dia.) were also affixed to the dummy to serve as photographic targets that would allow the position and orientation of various segments to be determined from reduction and analysis of high speed camera films. The general locations of these targets, each identified by a number, are shown in the four-view sketch of the dummy presented in Figure 11.

Where possible, targets were located at points where the skeletal structure was readily accessible through existing holes in the dummy flesh such as, for example, the bolts for the pin joints at the shoulder, elbow and knee. However, because the spatial location of at least three points on a rigid body must be known to determine its position and orientation, and because some targets might at times be shielded from the view of cameras, many additional targets were necessary. The balls were attached to the skeletal structure of the limb segments with small screws, using standoffs of 0.25 inch aluminum tubing of appropriate lengths so the balls would clear the dummy skin. For the head, upper torso, lower torso and femur (i.e., the proximal portion of the upper leg) segments, special brackets were fabricated on which the photographic targets were mounted.

Table 1 lists the coordinates of the center of each target with respect to a local reference axis system in each segment. The axis systems and locations of the targets on the various segments are illustrated in Figure 12 (a-m). Note that the two targets at each knee joint are common to both the upper and lower leg segments. Also, because of the joint in the lower leg that provides for eversion and inversion motions of the foot, the ankle targets (Nos. 51, 52 and 63, 64) are not fixed with respect to the lower leg axes and hence should not be used for determining the position and orientation of the lower leg segments.

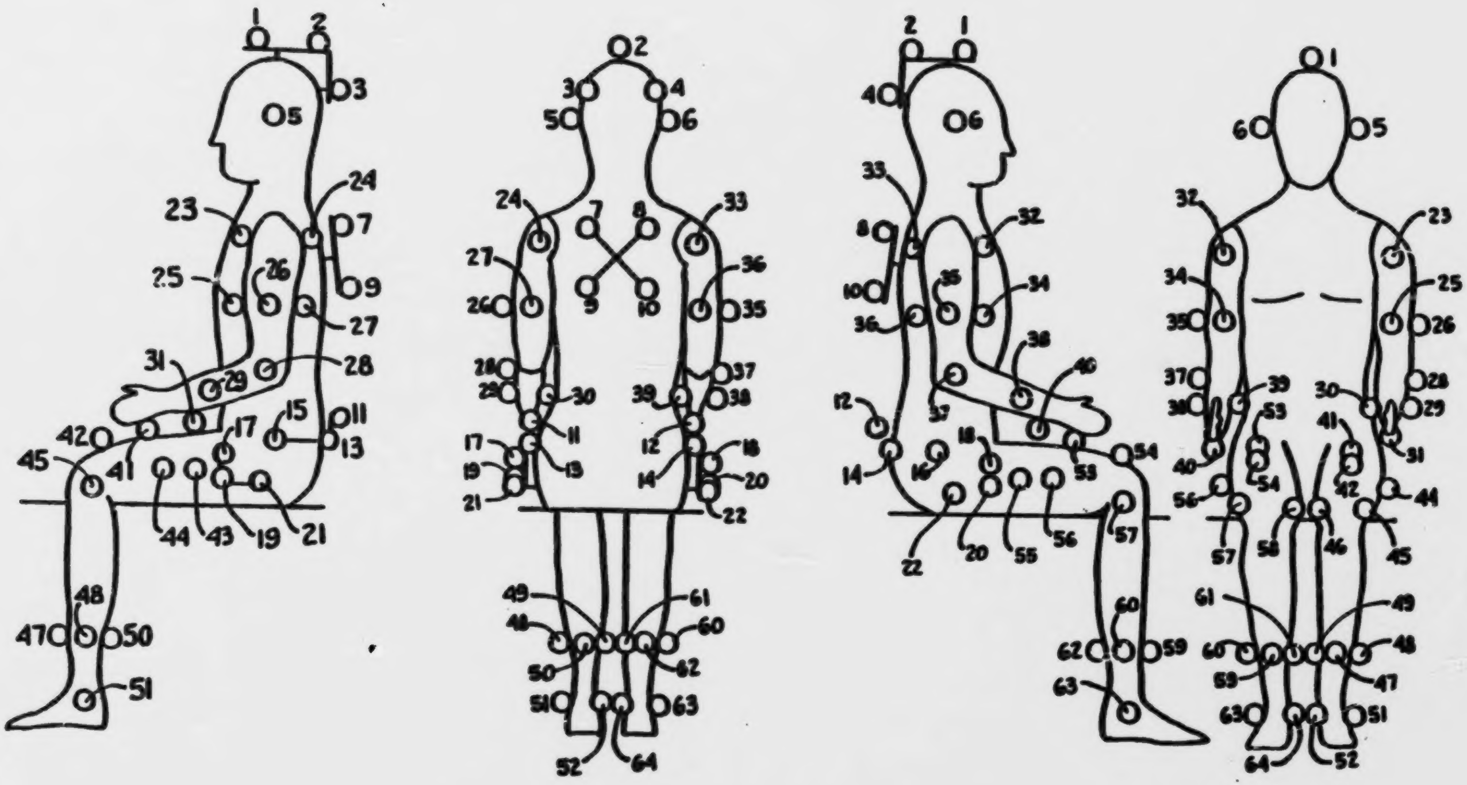

1
2
3
5
24
7
23
26
25
9
27
28
31
29
15
11
42
17
13
45
41
44
43
19
21
48
47
50
51
2
3
4
5
6
24
7
8
33
27
36
26
9
10
35
28
37
29
30
39
38
17
11
12
18
19
13
14
20
21
22
49
61
48
60
50
62
51
63
52
64
2
1
4
6
33
32
8
10
35
34
36
38
40
12
37
18
14
16
53
54
22
20
55
56
57
60
62
59
63
1
6
5
32
23
34
25
35
26
37
39
30
28
38
53
41
29
40
54
42
31
56
44
57
58
46
45
61
49
60
48
59
47
63
51
64
52

Figure 11 GENERAL LOCATIONS OF DUMMY PHOTOGRAPHIC TARGETS

BEST_DOCUMENT AVAILABLE

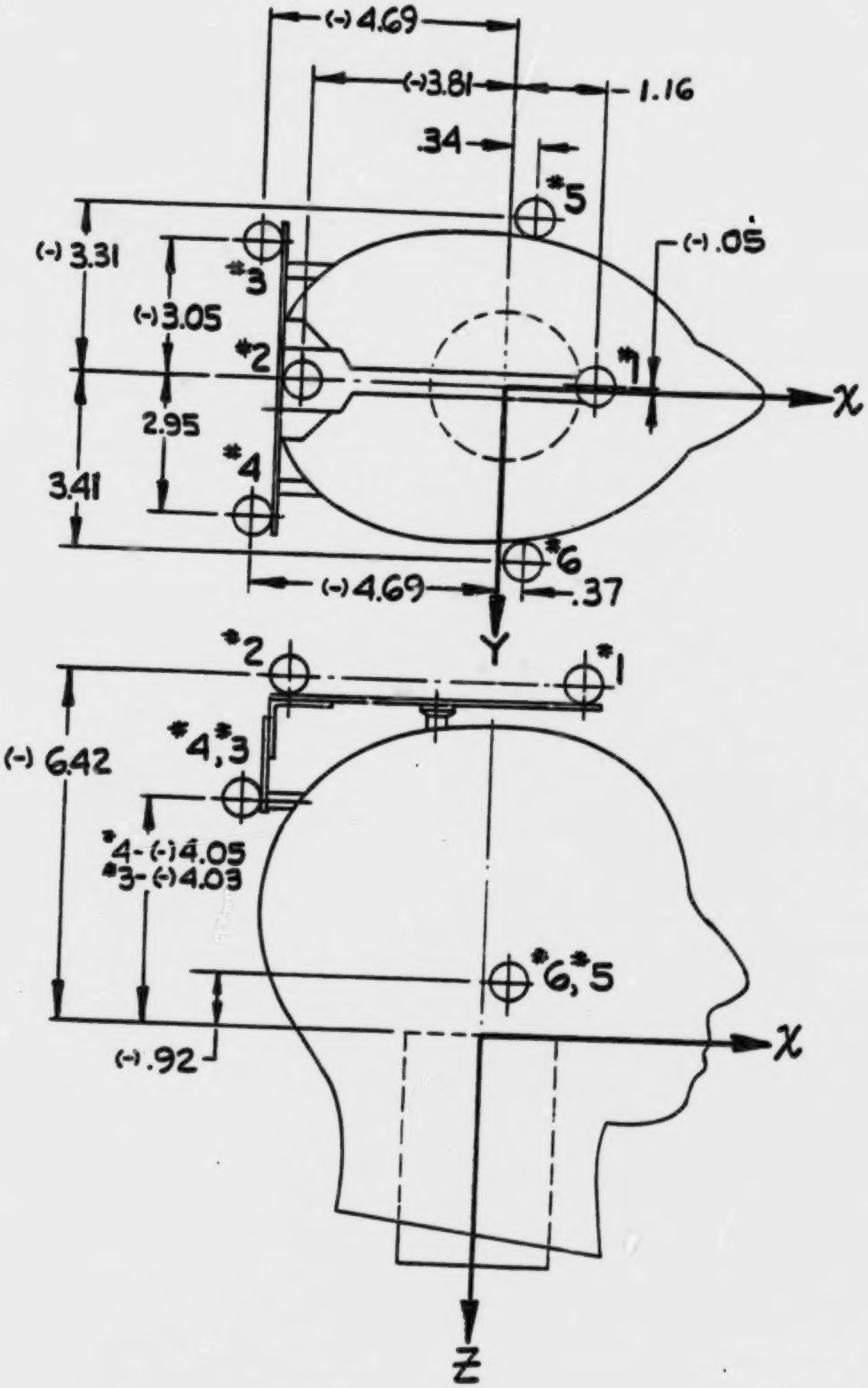
Table 1

DUMMY SEGMENT TARGET LOCATIONS

Target Location	Target No.	Target Color	X	Y	Z	Ref. Fig. 12
Top of Head	1	G	1.16	-0.05	-6.42	(a)
Top of Head	2	Y	-3.81	0.00	-6.42	(a)
Back of Head	3	Y	-4.69	-3.05	-4.03	(a)
Back of Head	4	O	-4.69	2.95	-4.05	(a)
Left Ear	5	G	0.34	-3.31	-0.92	(a)
Right Ear	6	O	0.37	3.41	-0.92	(a)
Upper Torso	7	G	-8.69	-2.44	-1821	(b)
Upper Torso	8	O	-8.69	3.12	-17.71	(b)
Upper Torso	9	O	-9.16	-3.00	-12.51	(b)
Upper Torso	10	Y	-9.19	2.59	-12.10	(b)
Lower Torso	11	G	-4.56	-6.88	-3.00	(c)
Lower Torso	12	Y	-4.56	6.88	-3.00	(c)
Lower Torso	13	O	-4.00	-6.88	-0.01	(c)
Lower Torso	14	O	-4.00	6.88	-0.01	(c)
Lower Torso	15	Y	0.00	-6.88	-0.02	(c)
Lower Torso	16	G	0.00	6.88	-0.02	(c)
Left Femur	17	Y	2.23	-4.58	0.00	(h)
Right Femur	18	Y	2.23	4.58	0.00	(k)
Left Femur	19	G	0.00	-4.58	0.00	(h)
Right Femur	20	G	0.00	4.58	0.00	(k)
Left Femur	21	O	-0.77	-4.58	-3.00	(h)
Right Femur	22	O	-0.77	4.58	-3.00	(k)
Left Shoulder	23	O	2.17	0.00	-10.32	(d)
Left Shoulder	24	Y	-2.46	0.00	-10.32	(d)
Left Upper Arm	25	Y	2.53	-0.04	-4.89	(d)
Left Upper Arm	26	G	0.00	-2.05	-4.91	(d)
Left Upper Arm	27	O	-2.56	0.03	-4.77	(d)
Left Elbow	28	O	0.00	-2.47	0.00	(e)
Left Lower Arm	29	Y	0.00	-1.80	6.02	(e)
Left Lower Arm	30	Y	0.08	1.76	5.96	(e)
Left Lower Arm	31	G	-1.86	0.00	7.53	(e)

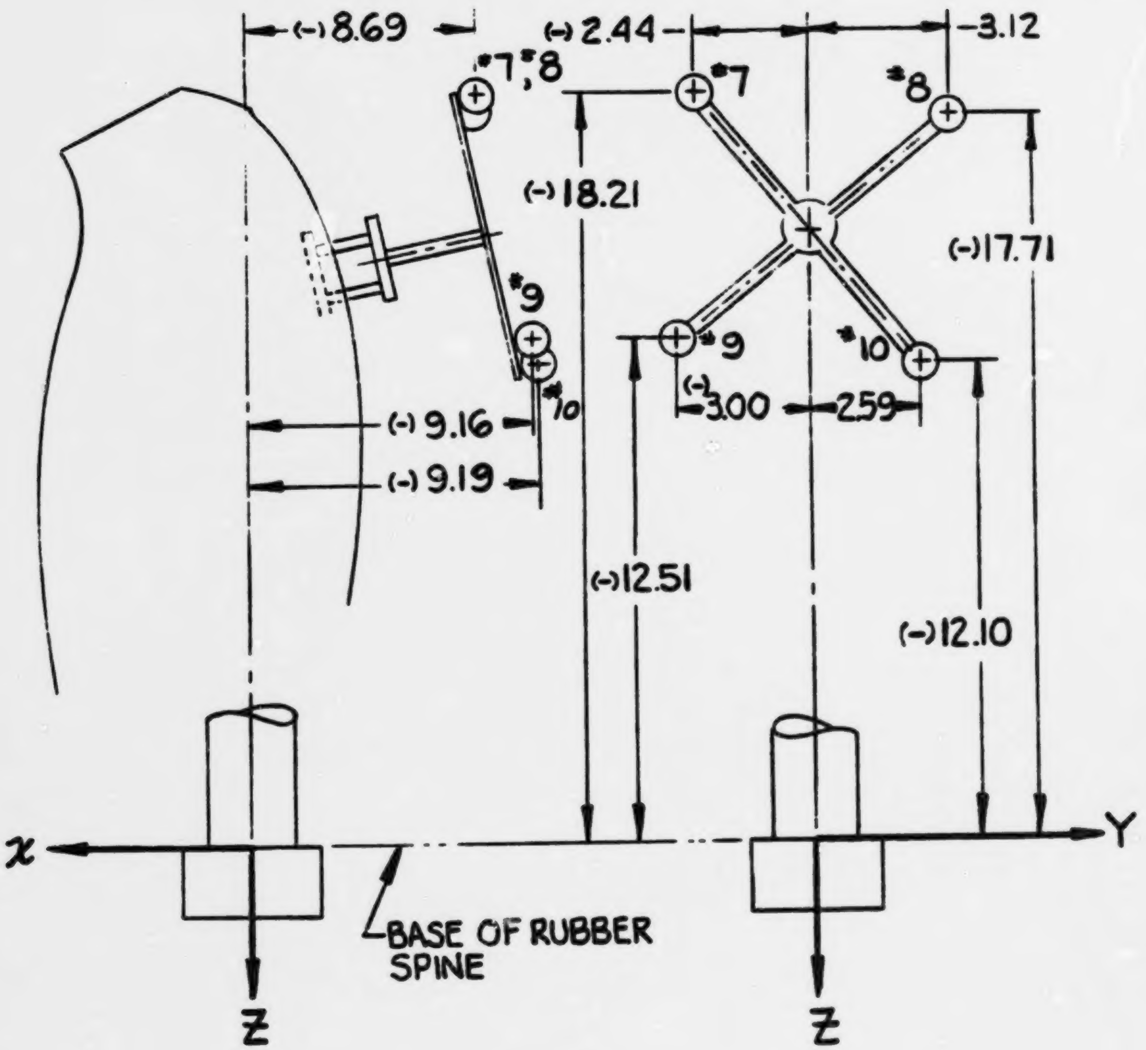
Table 1 (Continued)

Target Location	Target No.	Target Color	X	Y	Z	Ref. Fig. 12
Right Shoulder	32	G	2.18	0.00	-10.33	(f)
Right Shoulder	33	Y	-2.46	0.00	-10.33	(f)
Right Upper Arm	34	O	2.53	0.01	-4.86	(f)
Right Upper Arm	35	G	0.00	1.81	-4.92	(f)
Right Upper Arm	36	Y	-2.55	0.09	-4.82	(f)
Right Elbow	37	O	0.00	2.46	0.00	(g)
Right Lower Arm	38	G	0.00	1.80	5.98	(g)
Right Lower Arm	39	G	0.00	-1.81	6.00	(g)
Right Lower Arm	40	O	-1.68	0.00	7.49	(g)
Left Upper Leg	41	O	3.76	0.00	-6.05	(i)
Left Upper Leg	42	G	3.42	0.00	-2.09	(i)
Left Upper Leg	43	O	0.20	-3.95	-10.65	(i)
Left Upper Leg	44	Y	0.26	-3.95	-8.02	(i)
Left Knee	45	G	0.00	-2.63	0.00	(i)(j)
Left Knee	46	G	0.00	2.94	0.00	(i)(j)
Left Lower Leg	47	Y	1.88	0.00	11.35	(j)
Left Lower Leg	48	O	-0.11	-1.94	11.13	(j)
Left Lower Leg	49	G	-0.17	2.13	11.06	(j)
Left Lower Leg	50	Y	-2.23	0.00	10.71	(j)
Left Ankle	51	O	0.00	-1.91	16.25	(j)
Left Ankle	52	O	0.00	1.73	16.25	(j)
Right Upper Leg	53	G	3.74	0.00	-6.09	(l)
Right Upper Leg	54	O	3.35	0.00	-2.16	(l)
Right Upper Leg	55	O	-0.01	4.00	-10.73	(l)
Right Upper Leg	56	Y	0.09	4.00	-8.12	(l)
Right Knee	57	O	0.00	2.63	0.00	(l)(m)
Right Knee	58	O	0.00	-2.94	0.00	(l)(m)
Right Lower Leg	59	G	1.76	0.00	11.30	(m)
Right Lower Leg	60	O	0.00	2.10	11.30	(m)
Right Lower Leg	61	G	-0.01	-2.04	11.06	(m)
Right Lower Leg	62	Y	-2.39	0.00	10.71	(m)
Right Ankle	63	Y	0.00	1.87	16.25	(m)
Right Ankle	64	Y	0.00	-1.73	16.25	(m)


(-) 4.69
(-)3.81
1.16
.34
*5
(-) 3.31
*3
(-).05
(-)3.05
*2
*1
x
2.95
*4
3.41
*6
(-) 4.69
.37
Y
*2
*1
(-) 6.42
*4,*3
*4-(-)4.05
*3-(-)4.03
*6,*5
x
(-).92
Z

(a) HEAD

Figure 12 ILLUSTRATION OF DUMMY SEGMENT AXES AND TARGET POSITIONS



(-) 8.69
(-) 2.44
-3.12
#7, #8
#7
#8
(-) 18.21
(-)17.71
#9
#9
#10
#10
(-) 3.00
2.59
(-) 9.16
(-) 9.19
(-)12.51
(-)12.10
x
Y
Z
Z
BASE OF RUBBER SPINE

(b) UPPER TORSO

Figure 12 (Cont'd.)

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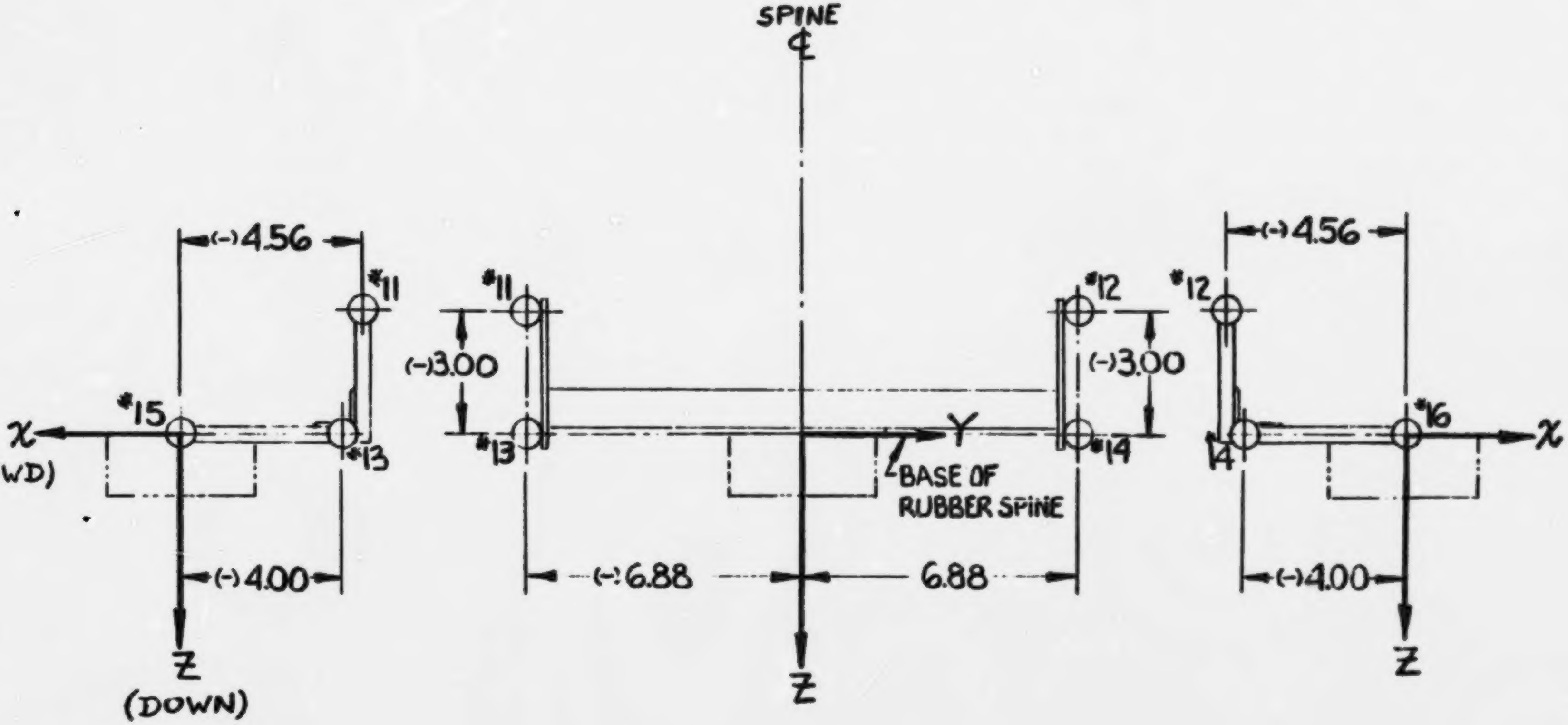
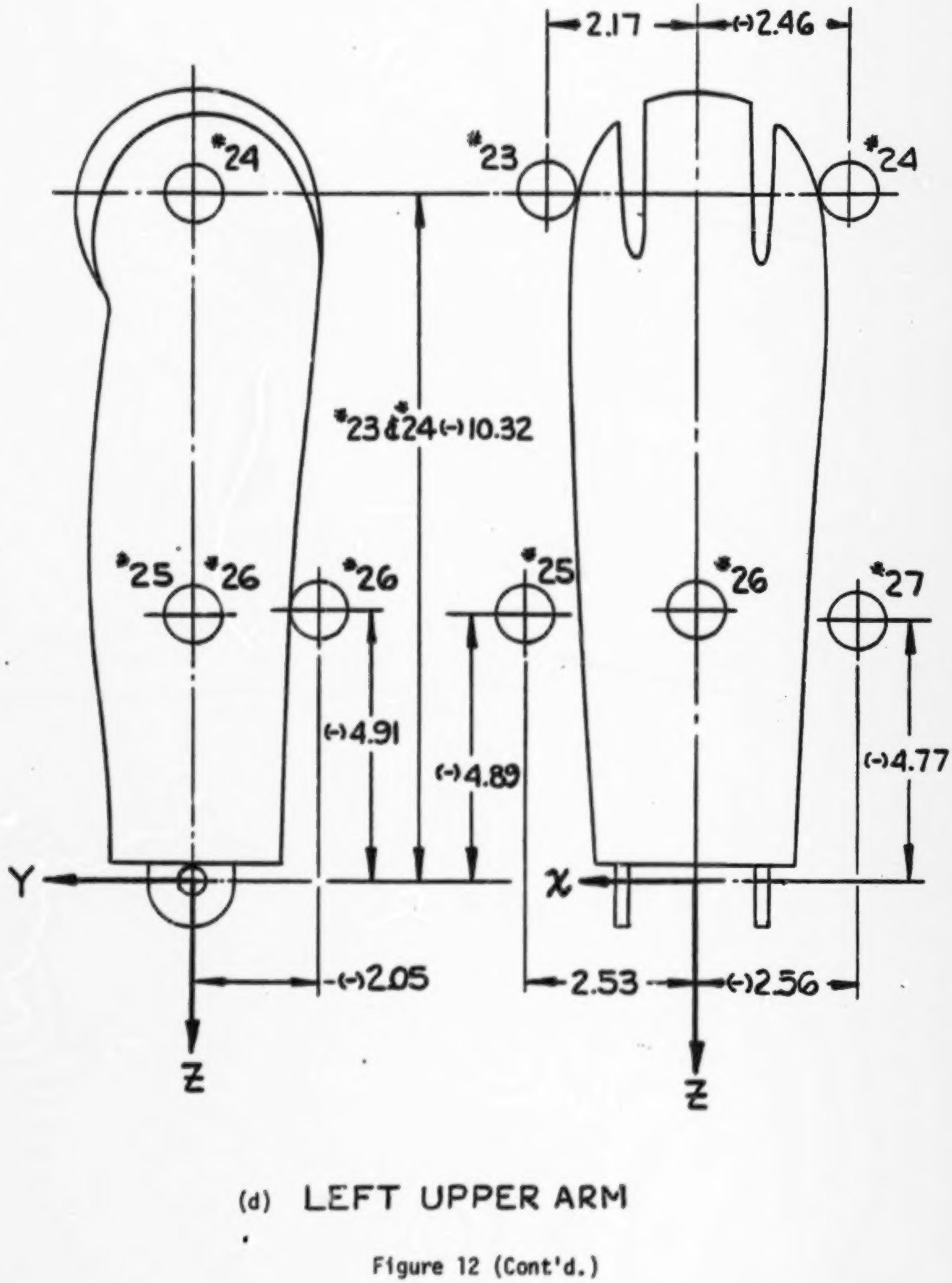

SPINE
℄
(-)4.56
*11
*15
x
(FWD)
*13
Z
(DOWN)
(-)4.00
*11
(-)3.00
*13
(-)6.88
6.88
Y
BASE OF
RUBBER SPINE
Z
*12
(-)3.00
*14
*12
(-)4.56
*16
x
14
(-)4.00
Z

(c) LOWER TORSO

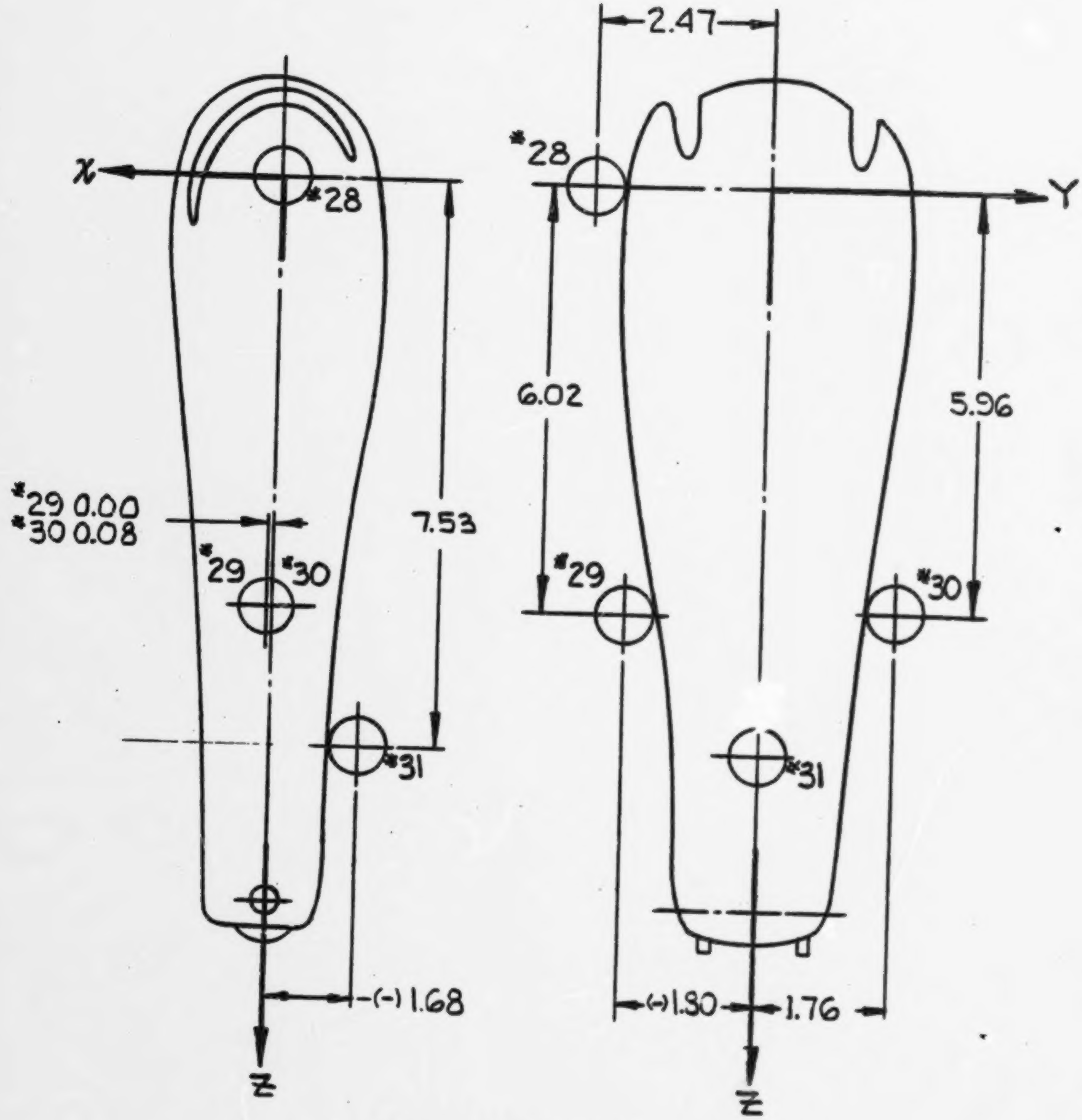
Figure 12 (Cont'd.)



2.17
(-)2.46
*24
*23
*24
*23 & *24 (-) 10.32
*25
*26
*26
*25
*26
*27
(-)4.91
(-)4.89
(-)4.77
Y
x
(-)2.05
2.53
(-)2.56
Z
Z

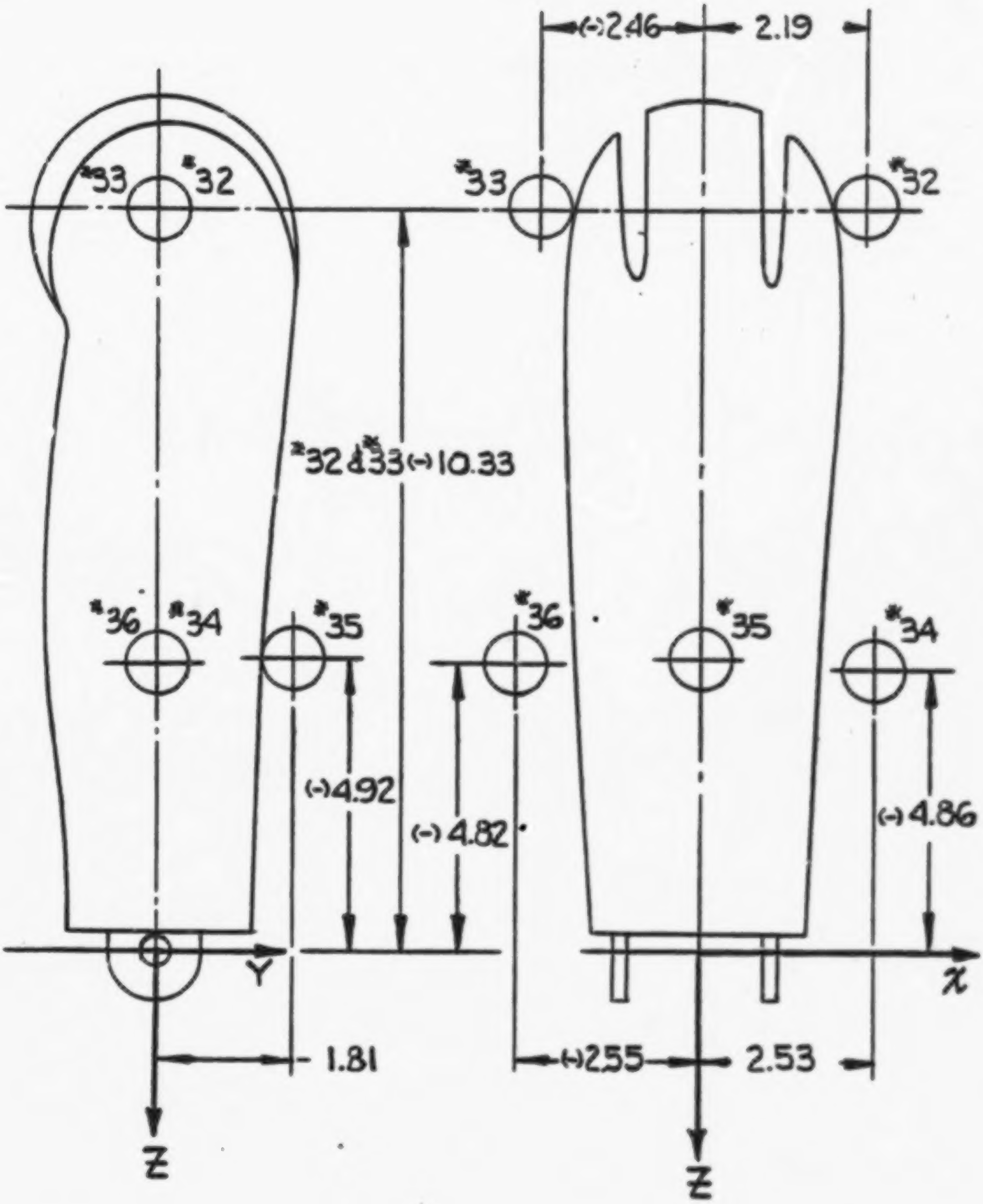
(d) LEFT UPPER ARM

Figure 12 (Cont'd.)


X
*28
Y
2.47
*28
6.02
5.96
*29 0.00
*30 0.08
7.53
*29
*30
*29
*30
*31
*31
(-) 1.68
(-) 1.80
1.76
Z
Z

(e) LEFT LOWER ARM

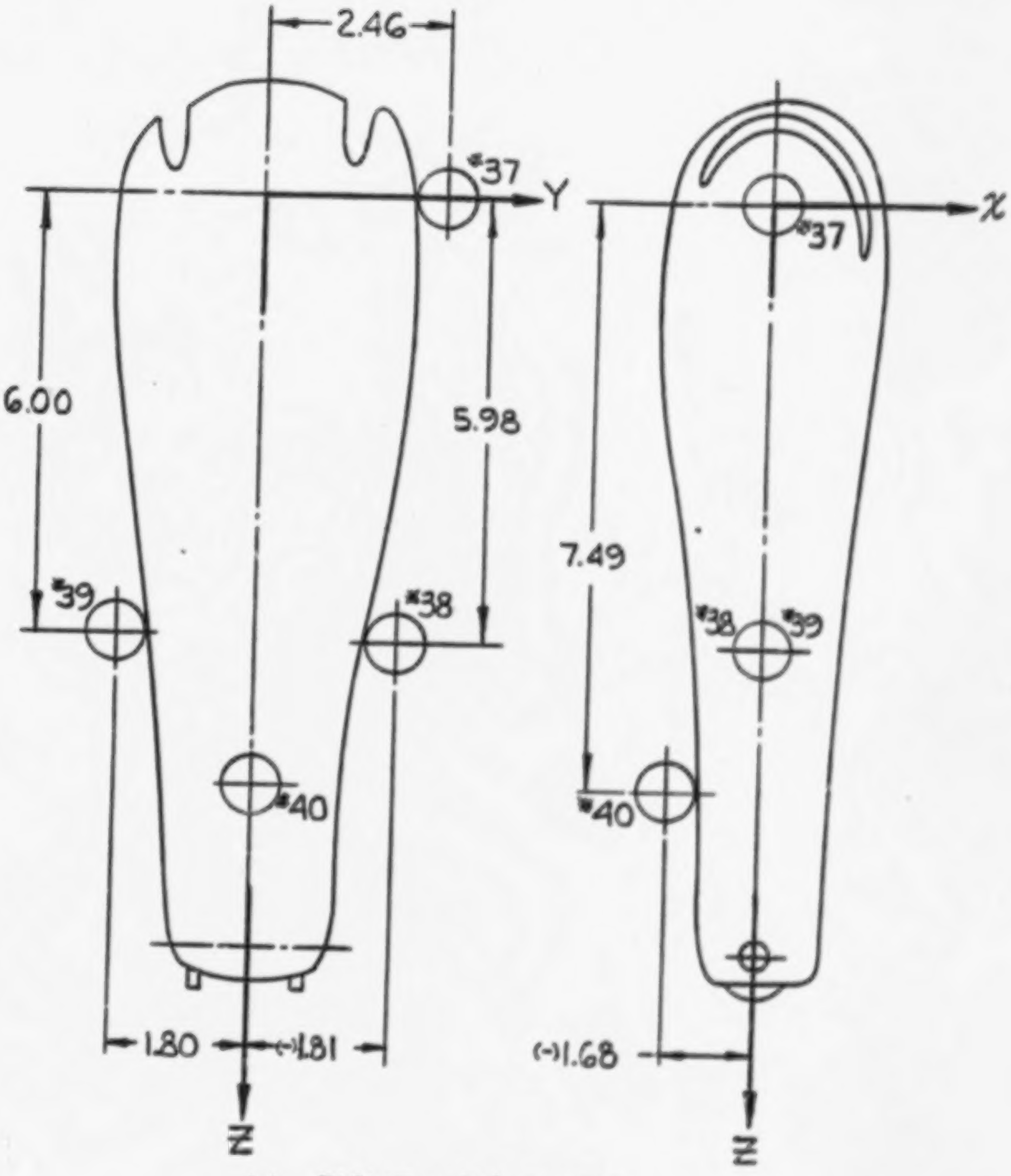
Figure 12 (Cont'd.)


(-)2.46
2.19
*33
*32
*33
*32
*32 & *33 (-) 10.33
*36
*34
*35
*36
*35
*34
(-)4.92
(-) 4.82
(-) 4.86
Y
x
1.81
(-)2.55
2.53
Z
Z

(f) RIGHT UPPER ARM

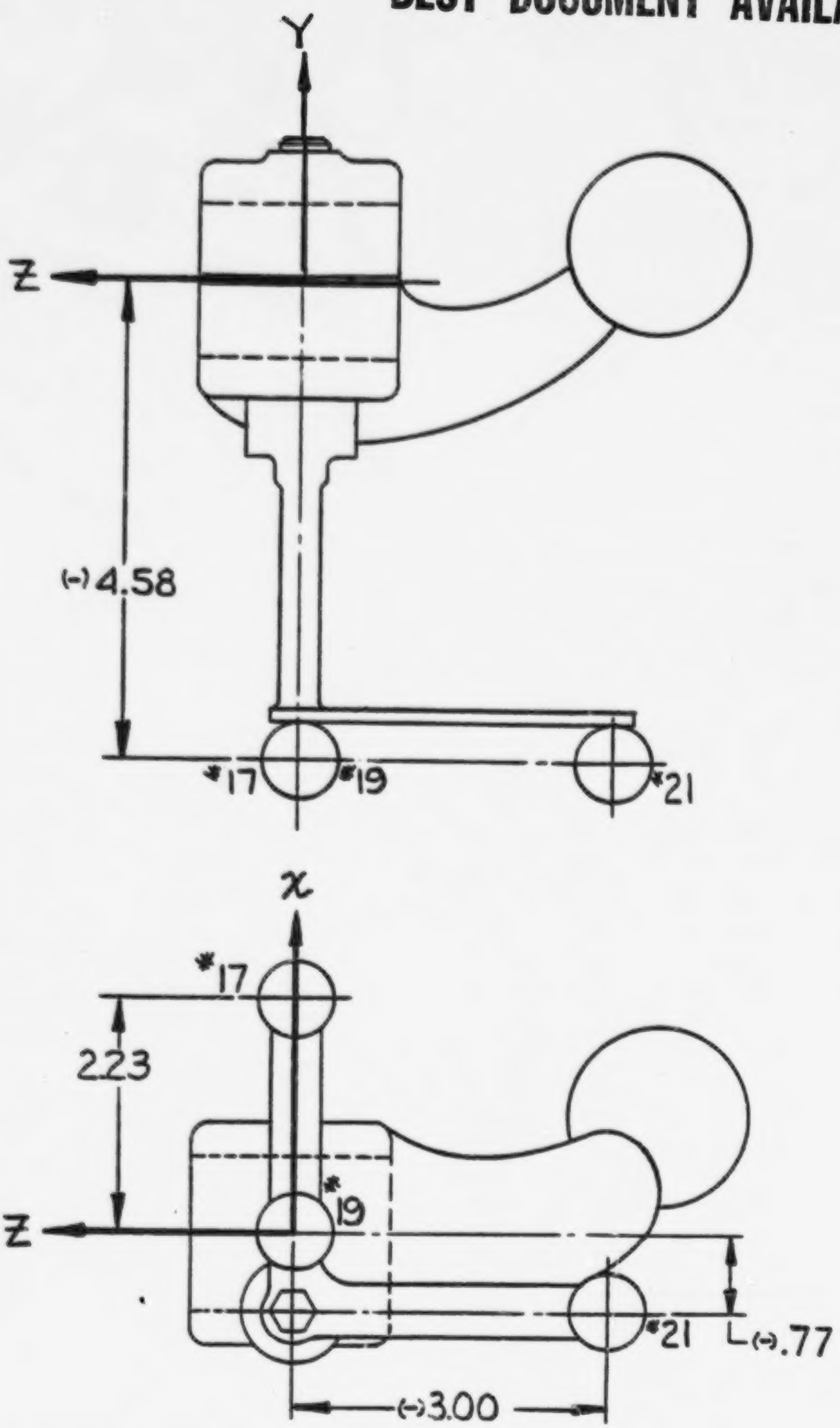
Figure 12 (Cont'd.)

BEST DOCUMENT AVAILABLE


2.46
*37
Y
6.00
5.98
*39
*38
*40
1.80
(-)1.81
Z
x
*37
7.49
*38
*39
*40
(-)1.68
Z

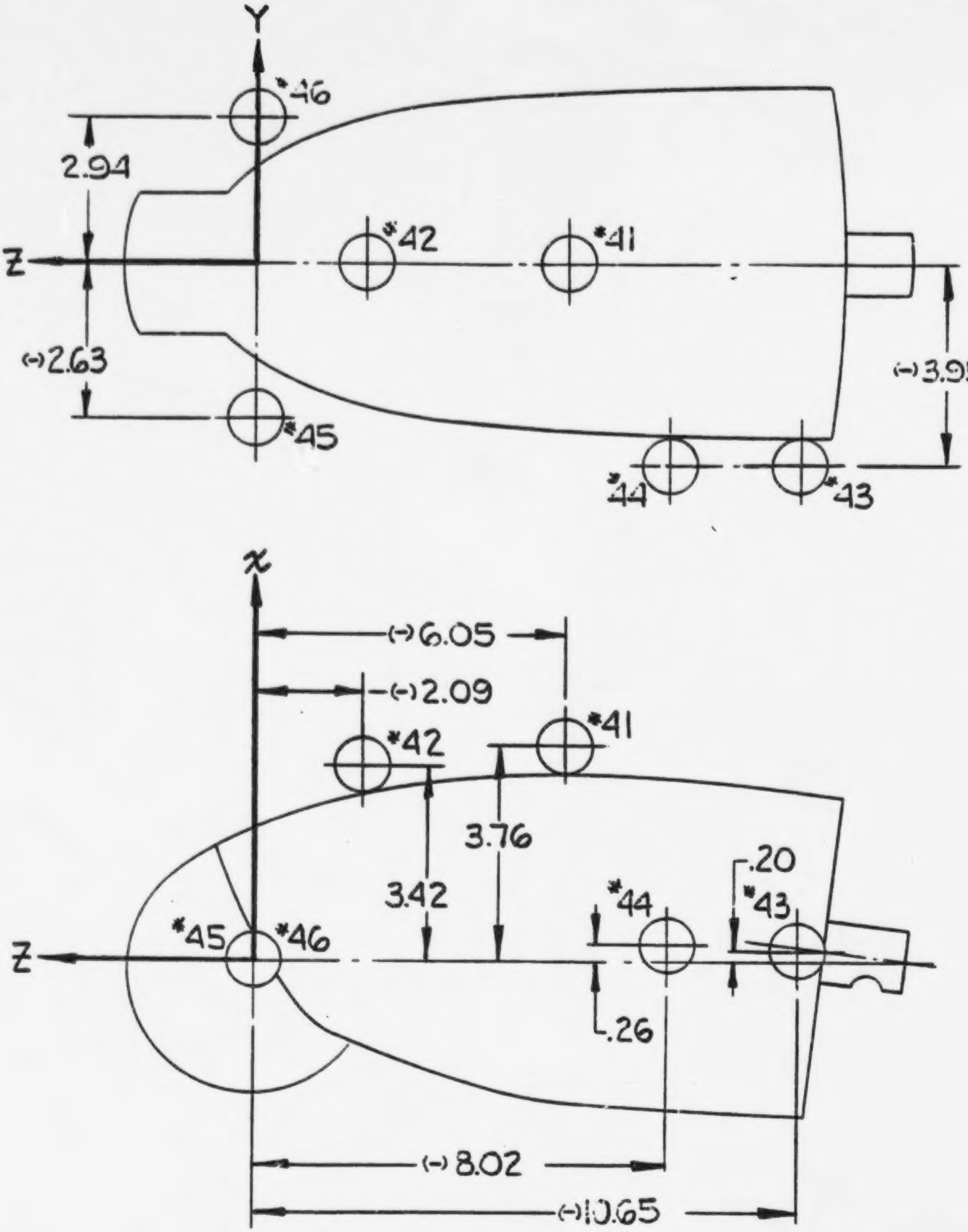
(g) RIGHT LOWER ARM

Figure 12 (Cont'd.)


Y
Z
(-)4.58
*17
*19
*21
x
*17
2.23
*19
Z
*21
L(-).77
(-)3.00

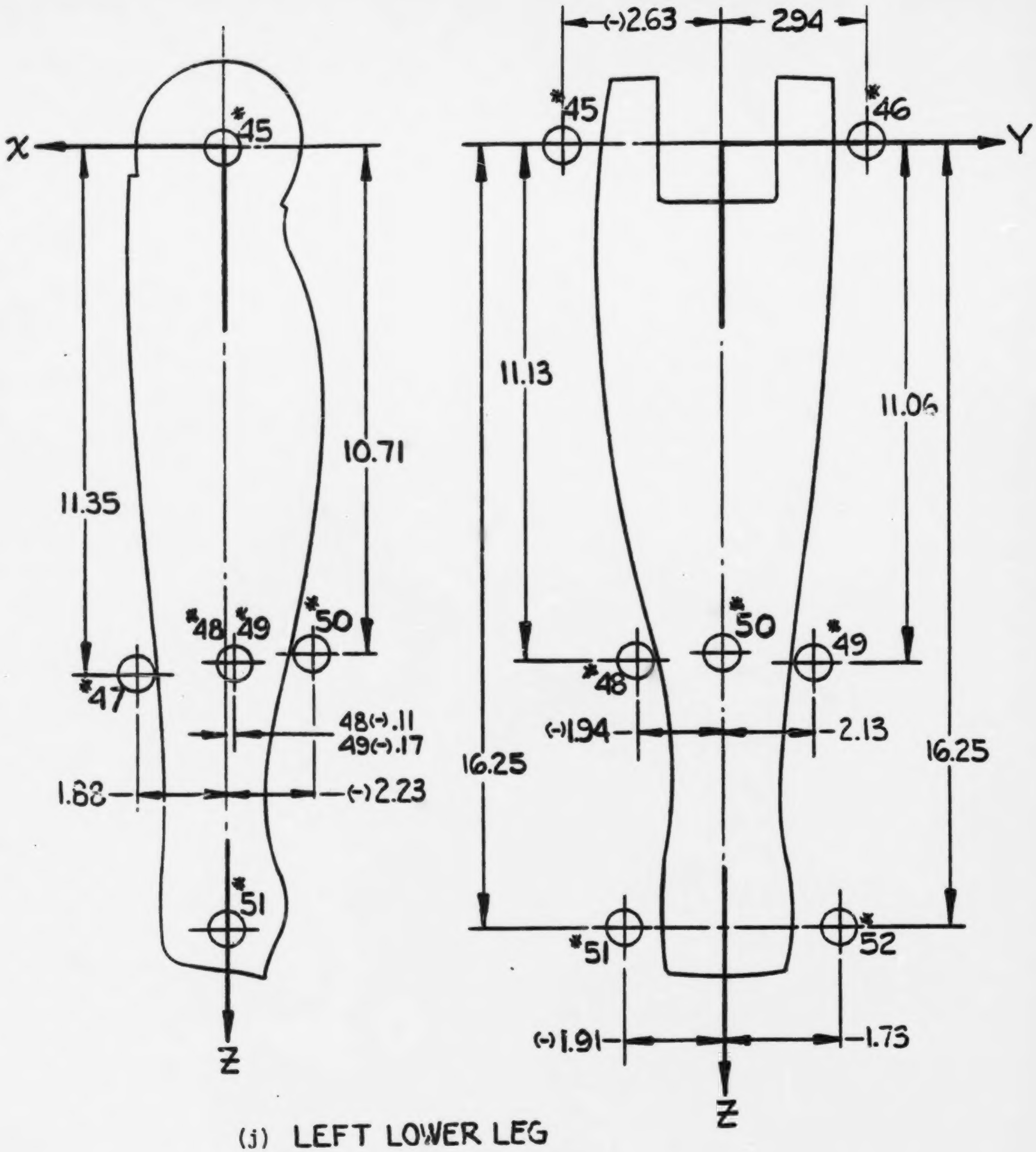
(h) LEFT FEMUR

Figure 12 (Cont'd.)


Y
*46
2.94
*42
*41
Z
(-)2.63
(-)3.95
*45
*44
*43
x
(-)6.05
(-)2.09
*42
*41
3.76
3.42
.20
*44
*43
*45
*46
Z
.26
(-) 8.02
(-)10.65

(i) LEFT UPPER LEG

Figure 12 (Cont'd.)


x
*45
11.35
10.71
*47
*48
*49
*50
48(-).11
49(-).17
1.88
(-)2.23
*51
Z
(-)2.63
2.94
*45
*46
Y
11.13
11.06
*50
*49
*48
(-)1.94
2.13
16.25
16.25
*51
*52
(-)1.91
1.73
Z

(j) LEFT LOWER LEG

Figure 12 (Cont'd.)

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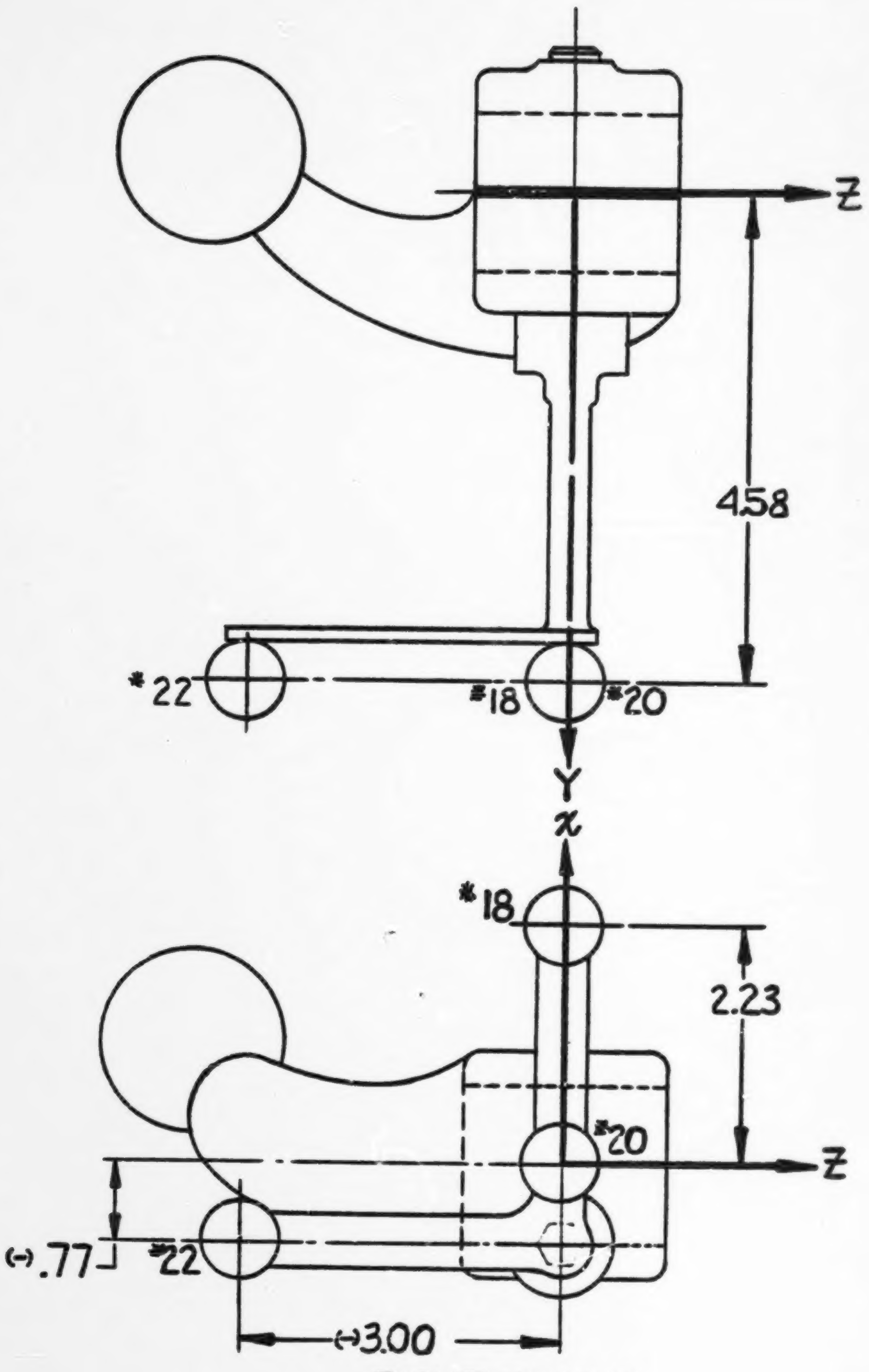
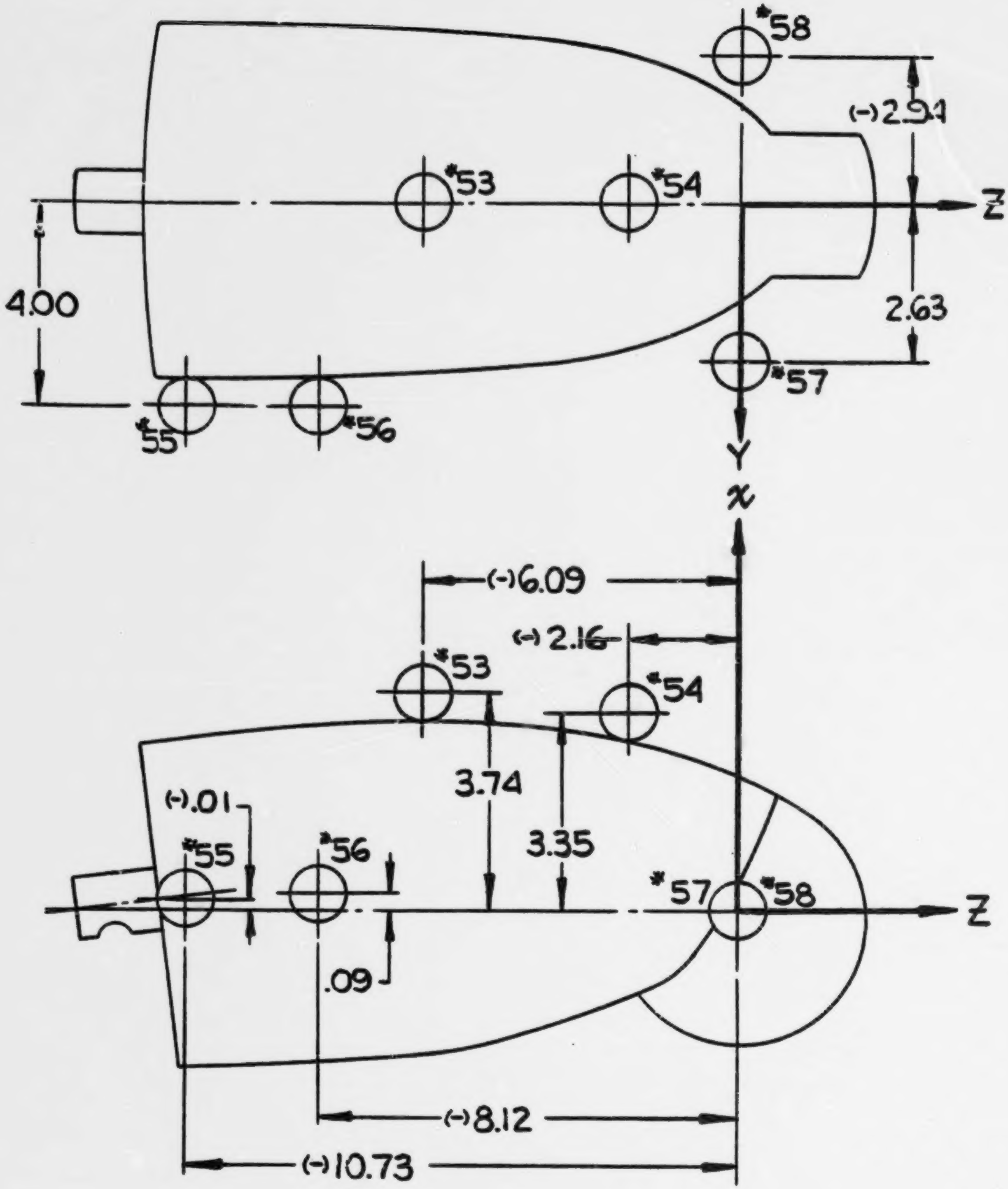

Z
4.58
*22
*18
*20
Y
x
*18
2.23
*20
Z
(-).77
*22
(-)3.00

(k) RIGHT FEMUR

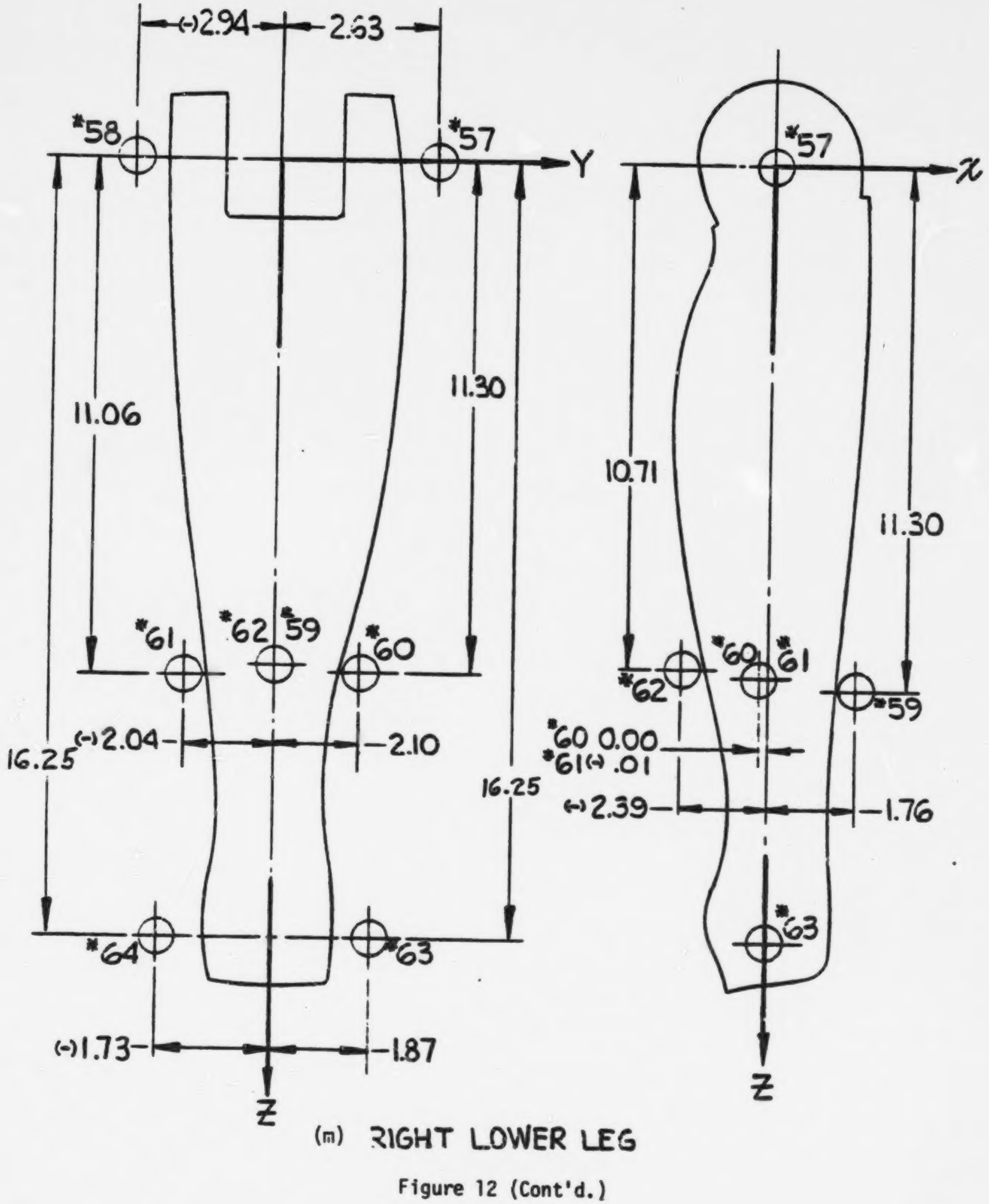
Figure 12 (Cont'd.)


*58
(-)2.94
*53
*54
Z
4.00
2.63
*57
*55
*56
Y
x
(-)6.09
(-)2.16
*53
*54
3.74
(-).01
3.35
*55
*56
*57
*58
Z
.09
(-)8.12
(-)10.73

(1) RIGHT UPPER LEG

Figure 12 (Cont'd.)

BEST DOCUMENT AVAILABLE


(-)2.94
2.63
*58
*57
Y
*57
x
11.06
11.30
10.71
11.30
*61
*62
*59
*60
*60
*61
*62
*59
16.25
(-)2.04
2.10
*60 0.00
*61(-) .01
16.25
(-)2.39
1.76
*64
*63
*63
(-)1.73
1.87
Z
Z

(m) RIGHT LOWER LEG

Figure 12 (Cont'd.)

2.5 Camera Coverage

Five high-speed (1000 fps) 16 mm film cameras mounted on the sled were used to provide left and right lateral, left and right rear quarter, and overhead views of the dummy for the air bag restraint tests. For the belt restraint tests, a sixth camera was installed on the sled to photograph the dummy from headon. The measured positions of these cameras in the sled buck reference frame are given in Figure 13. The moving pictures were obtained with Photo-Sonics Model 16 mm 1B cameras equipped with an 8 mm lens for which the serial numbers are listed in Table 2.

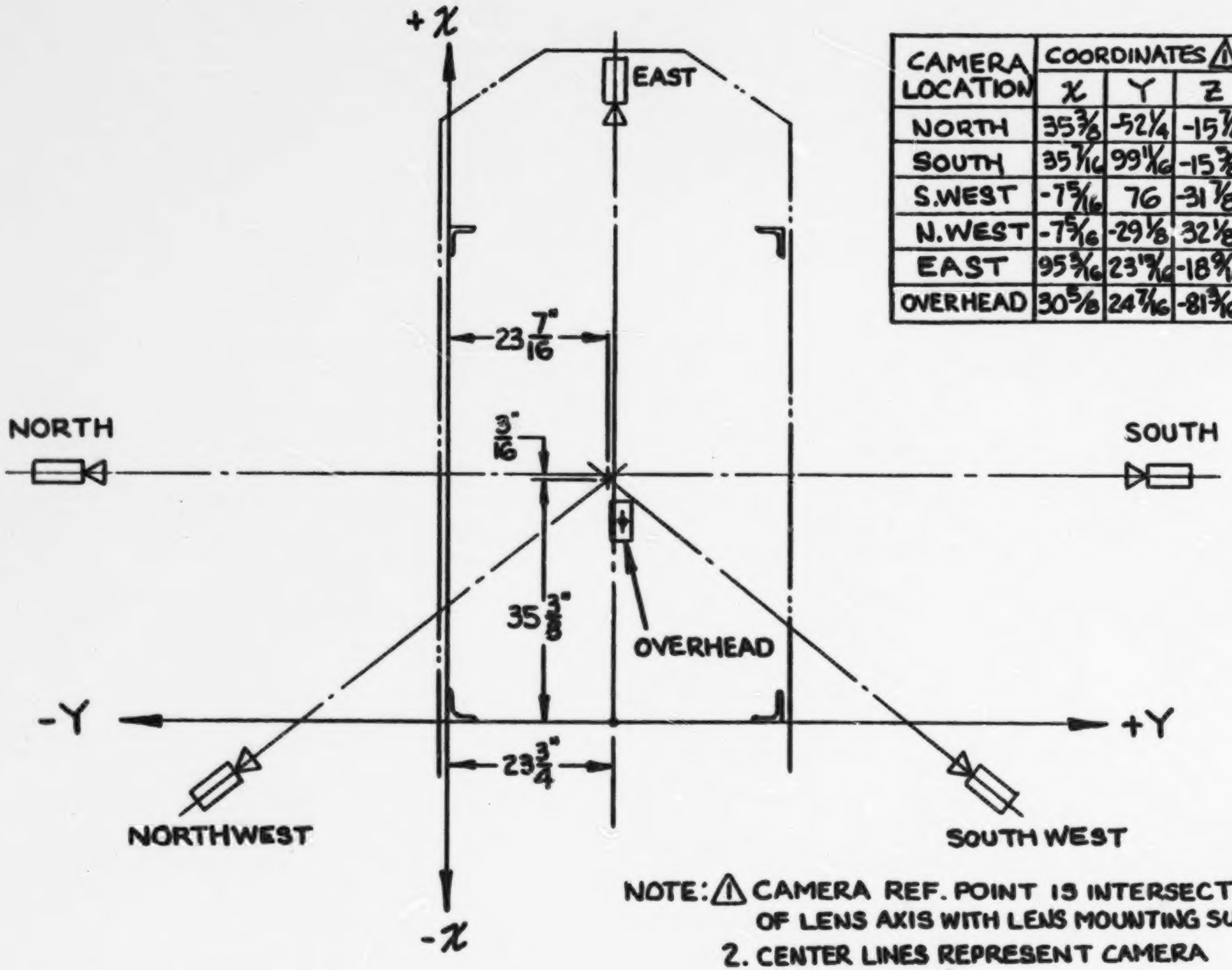
Table 2

ONBOARD HIGH-SPEED CAMERAS

Location	Camera	Lens
North	Photo-Sonics, S/N 1333	Red Lake, S/N 142
Northwest(1)	Photo-Sonics, S/N 1328	Red Lake, S/N 133
South(1)	Photo-Sonics, S/N 1329	Red Lake, S/N 152
Southwest	Photo-Sonics, S/N 1332	Photo-Sonics, S/N 204
East	Photo-Sonics, S/N 1325	Photo-Sonics, S/N 207
Overhead	Photo-Sonics, S/N 1327	Photo-Sonics, S/N 211

Note: (1) Northwest and South cameras were Photo-Sonics S/N 1331 and S/N 1330, respectively, for sled test No. 2044.

Numerous fixed targets were installed on the sled buck frame to provide reference points for calibration and determination of the position and orientation of the onboard cameras by resection techniques. The measured locations of these photographic targets in the sled buck coordinate axis system are given in Figure 14 (a-g).


+x
EAST
23 7/16"
3/16"
NORTH
SOUTH
35 3/8"
OVERHEAD
-Y
+Y
23 3/4"
NORTHWEST
SOUTH WEST
-x

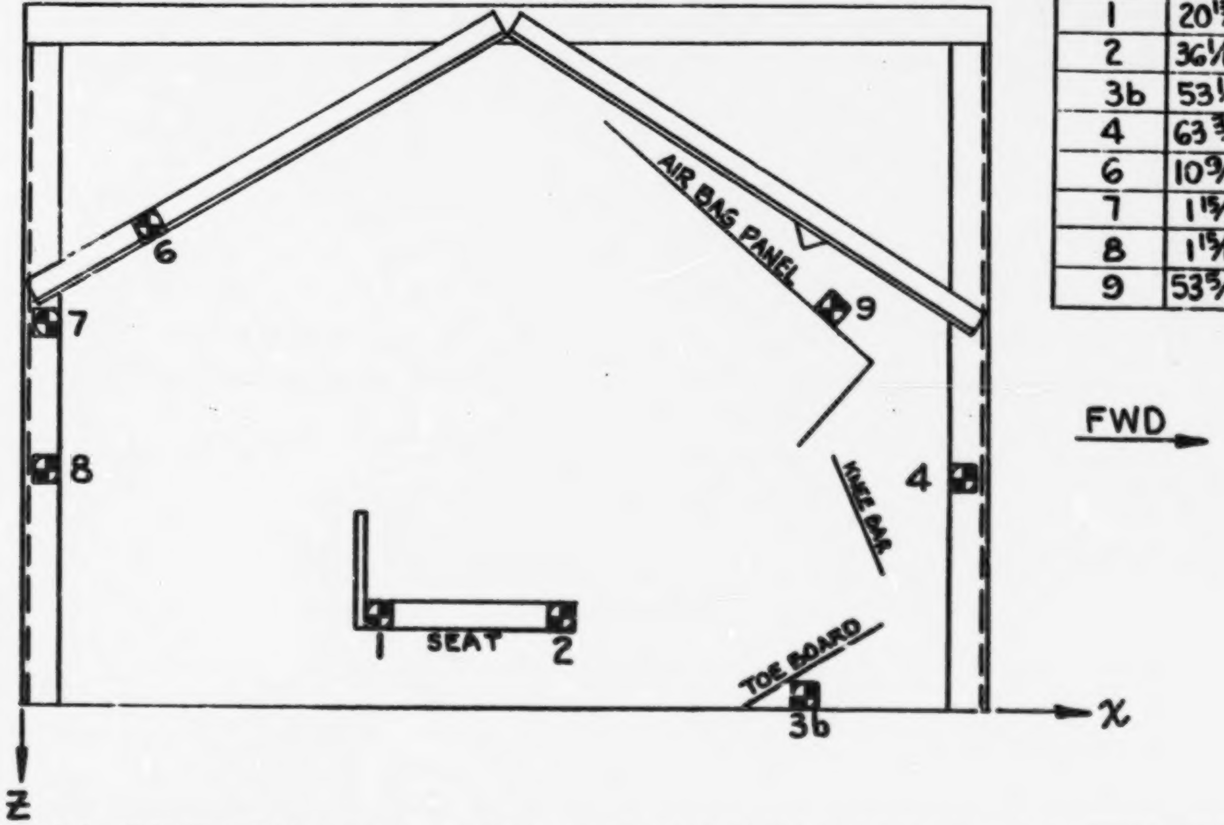
CAMERA LOCATION	COORDINATES ⚠			ELEVATION ANGLE
	x	Y	Z	
NORTH	35 3/8	-52 1/4	-15 7/8	3°32' UP
SOUTH	35 7/16	99 11/16	-15 3/8	3°15' UP
S.WEST	-7 5/16	76	-31 7/8	0°16' UP
N.WEST	-7 5/16	-29 1/8	32 1/8	0°30' UP
EAST	95 3/16	23 13/16	-18 9/16	0°42' DN
OVERHEAD	30 5/8	24 7/16	-81 3/16	0°1' AFT 0°19' RT

NOTE: ⚠ CAMERA REF. POINT IS INTERSECTION OF LENS AXIS WITH LENS MOUNTING SURFACE.

2. CENTER LINES REPRESENT CAMERA BORE SIGHT ℄

Figure 13 HIGH-SPEED CAMERA POSITIONS

TARGET NO.	COORDINATES ~ IN. X	Y	Z
1	20 13/16	32 1/8	-5 3/4
2	36 1/16	32	-5 7/8
3b	53 1/4	37 1/2	-1 1/16
4	63 3/8	47 3/8	-18 13/16
6	10 9/16	49 11/16	-40 1/8
7	1 15/16	47 7/8	-30 3/4
8	1 15/16	47 3/8	-18 3/4
9	53 5/16	38 3/8	-37 5/16


AIR BAG PANEL
KNEE BAR
TOE BOARD
SEAT
1
2
3b
4
6
7
8
9
FWD
x
Z

(a) SOUTH CAMERA VIEW OF FIXED TARGETS ON OUTSIDE OF FRAMEWORK, RIGHT SIDE OF BUCK.

Figure 14 LOCATIONS OF FIXED PHOTOGRAPHIC TARGETS ON SLED BUCK

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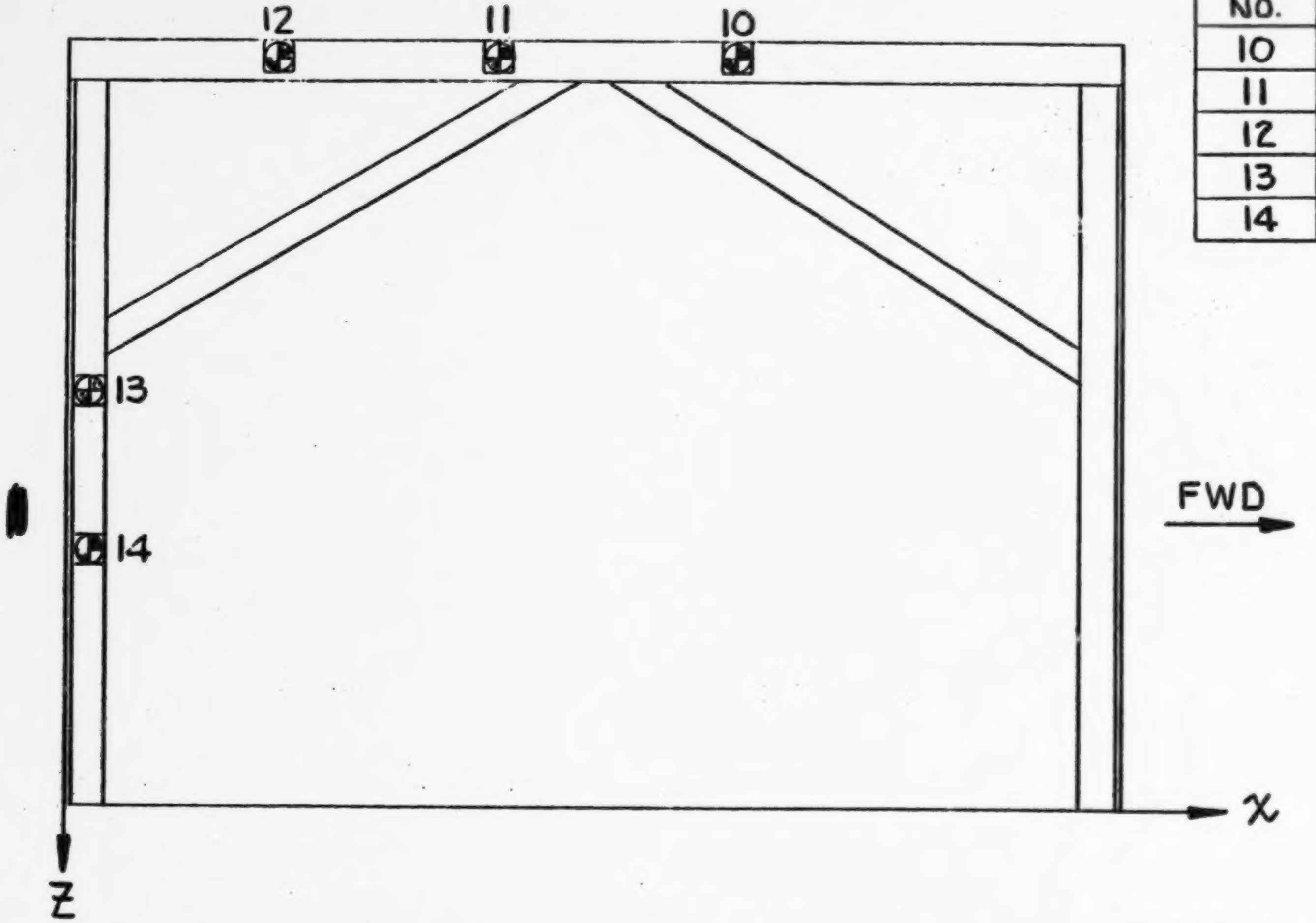
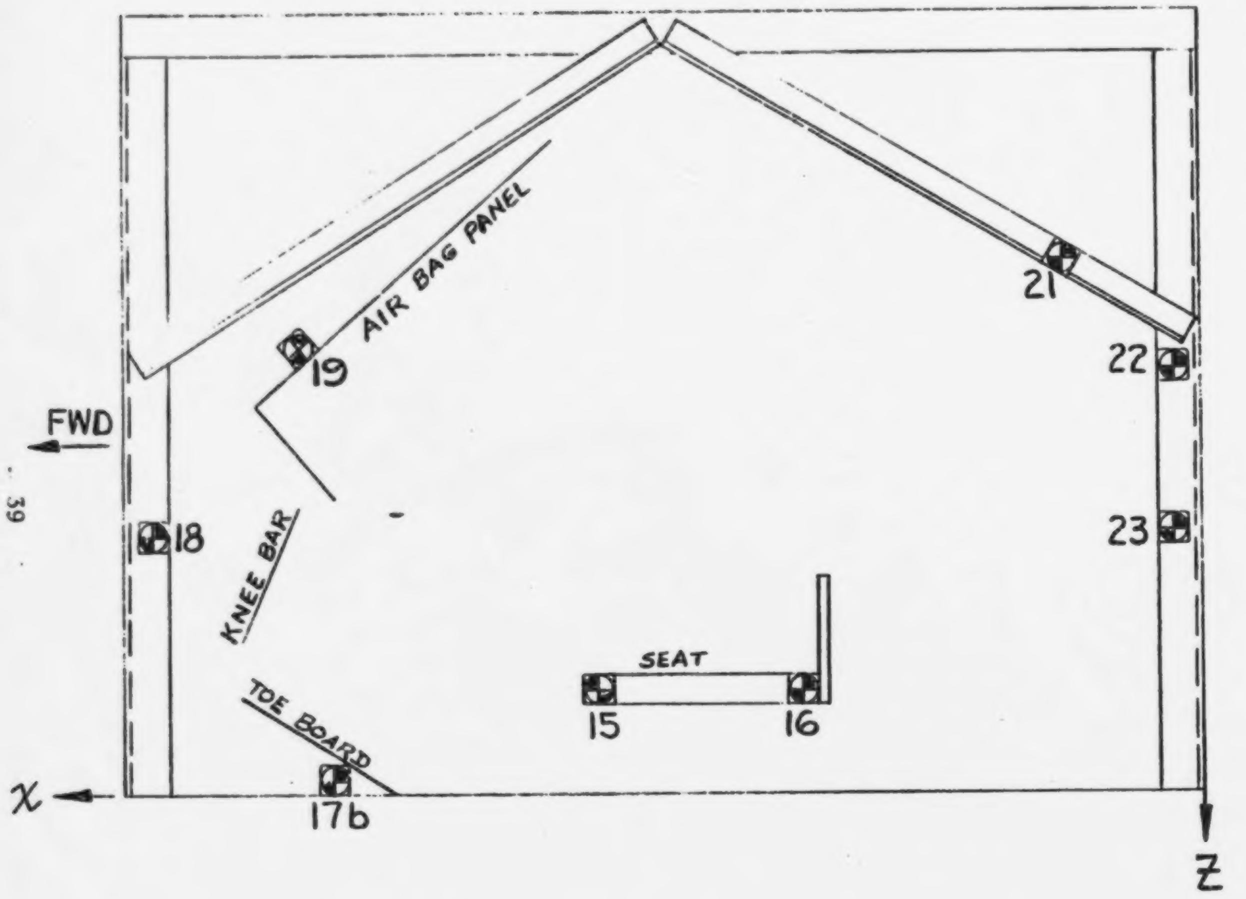
	COORDINATES ~ IN.		
TARGET NO.	x	Y	Z
10	$38\frac{3}{16}$	$\frac{5}{16}$	$-53\frac{15}{16}$
11	$26\frac{1}{8}$	$\frac{5}{16}$	$-53\frac{7}{8}$
12	$13\frac{15}{16}$	$\frac{5}{16}$	$-53\frac{7}{8}$
13	$1\frac{15}{16}$	$\frac{5}{16}$	$-30\frac{13}{16}$
14	$1\frac{7}{8}$	$\frac{5}{16}$	$-48\frac{13}{16}$



(b) SOUTH CAMERA VIEW OF FIXED TARGETS ON INSIDE OF FRAMEWORK, LEFT SIDE OF BUCK.

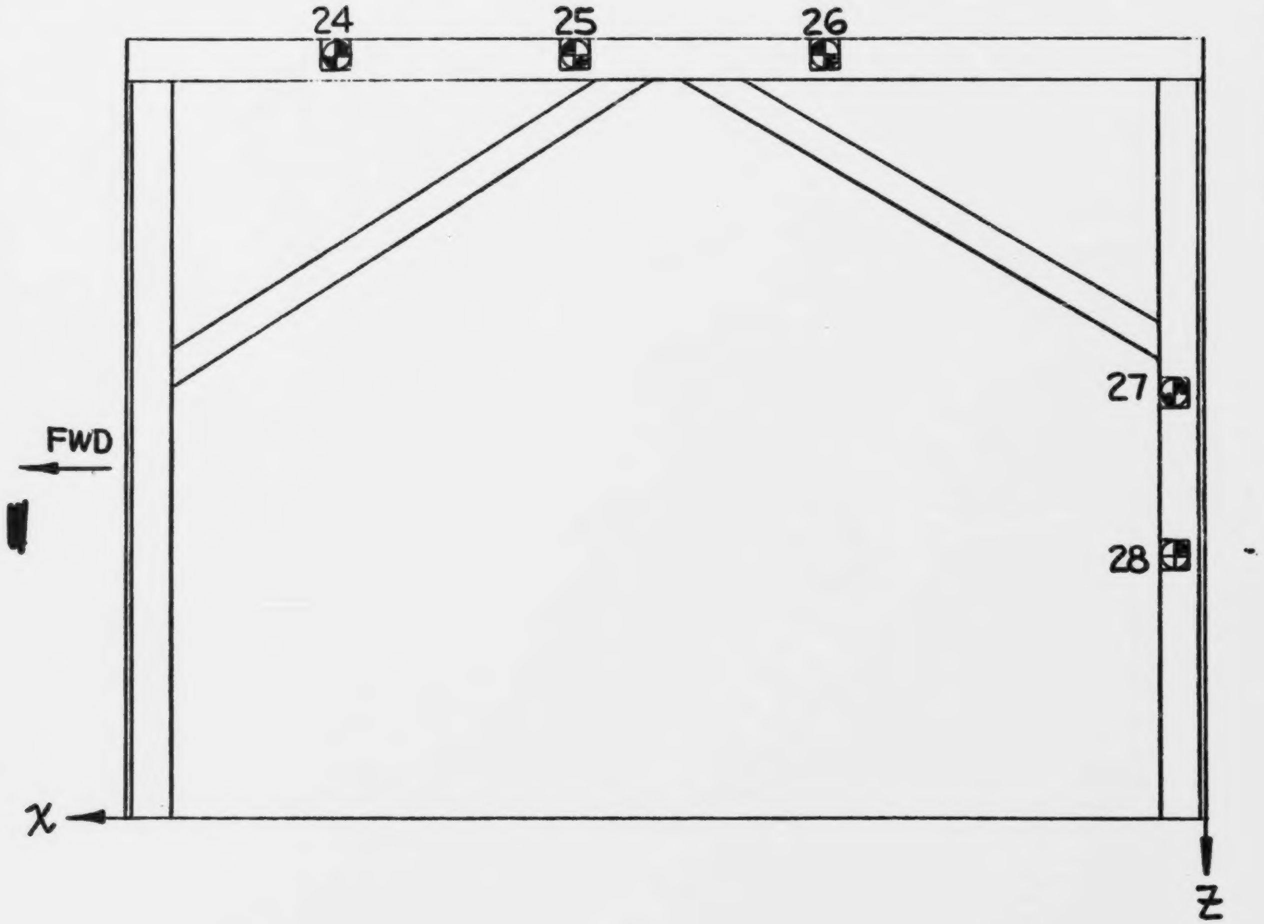
Figure 14 (Cont'd.)


AIR BAG PANEL
KNEE BAR
TOE BOARD
SEAT
FWD
X
Z
15
16
17b
18
19
21
22
23

TARGET NO.	COORDINATES ~ IN. X	Y	Z
15	36	15 9/16	-5 11/16
16	20 9/16	15 9/16	-5 1/2
17b	52 1/4	11	-1 1/16
18	63 5/16	0	-18 3/4
19	53 1/4	8 3/4	-37 1/2
21	12 1/8	-2 3/8	-41 3/8
22	2	0	-30 7/8
23	2	0	-18 3/4

(c) NORTH CAMERA VIEW OF FIXED TARGETS ON OUTSIDE OF FRAMEWORK, LEFT SIDE OF BUCK.

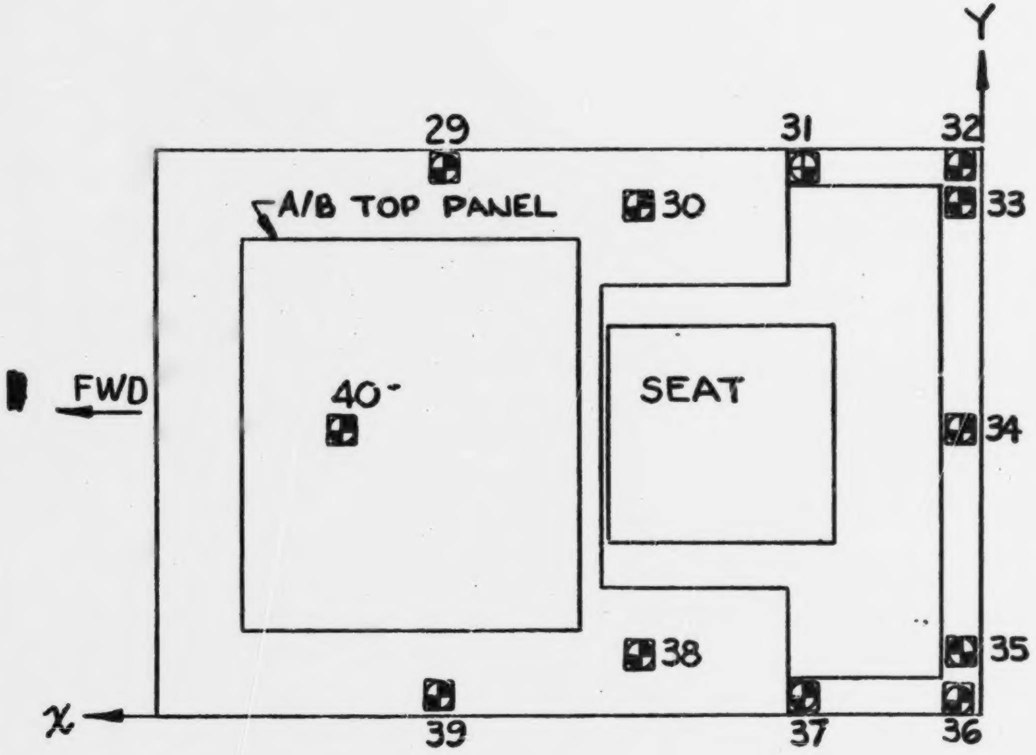
Figure 14 (Cont'd.)



TARGET NO.	COORDINATES ~ IN.		
	X	Y	Z
24	37 3/16	46 15/16	-53 3/4
25	25 13/16	46 7/8	-53 13/16
26	13 7/8	46 7/8	-53 13/16
27	1 7/8	47 1/16	-30 3/4
28	2	47 1/16	-18 13/16

(d) NORTH CAMERA VIEW OF FIXED TARGETS ON INSIDE OF FRAMEWORK, RIGHT SIDE OF BUCK.

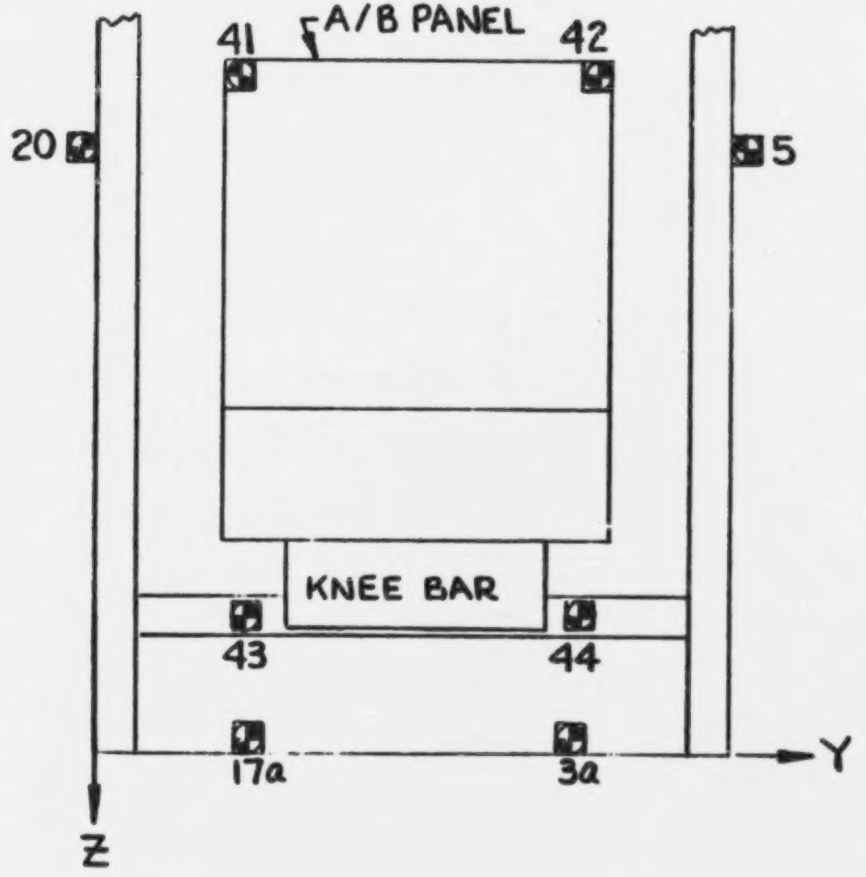
Figure 14 (Cont'd.)


Y
29
31
32
A/B TOP PANEL
30
33
FWD
40
SEAT
34
38
35
x
39
37
36

TARGET NO.	COORDINATES ~ IN.		
	X	Y	Z
29	$42\frac{3}{8}$	$46\frac{1}{4}$	0
30	$26\frac{1}{8}$	$42\frac{1}{4}$	0
31	$16\frac{1}{8}$	$45\frac{1}{2}$	$-\frac{3}{4}$
32	$1\frac{5}{16}$	$45\frac{1}{4}$	$-16\frac{9}{16}$
33	$1\frac{15}{16}$	$41\frac{1}{2}$	$-\frac{3}{4}$
34	$1\frac{7}{8}$	$23\frac{9}{16}$	$-\frac{3}{4}$
35	$1\frac{7}{8}$	6	$-\frac{3}{4}$
36	$1\frac{5}{16}$	2	$-16\frac{11}{16}$
37	$16\frac{1}{16}$	$1\frac{15}{16}$	$-\frac{3}{4}$
38	$26\frac{1}{8}$	$4\frac{15}{16}$	0
39	$42\frac{1}{4}$	$1\frac{1}{16}$	0
40	$40\frac{3}{4}$	$23\frac{3}{8}$	$-49\frac{3}{4}$

(e) OVERHEAD CAMERA VIEW OF FIXED TARGETS

Figure 14 (Cont'd.)

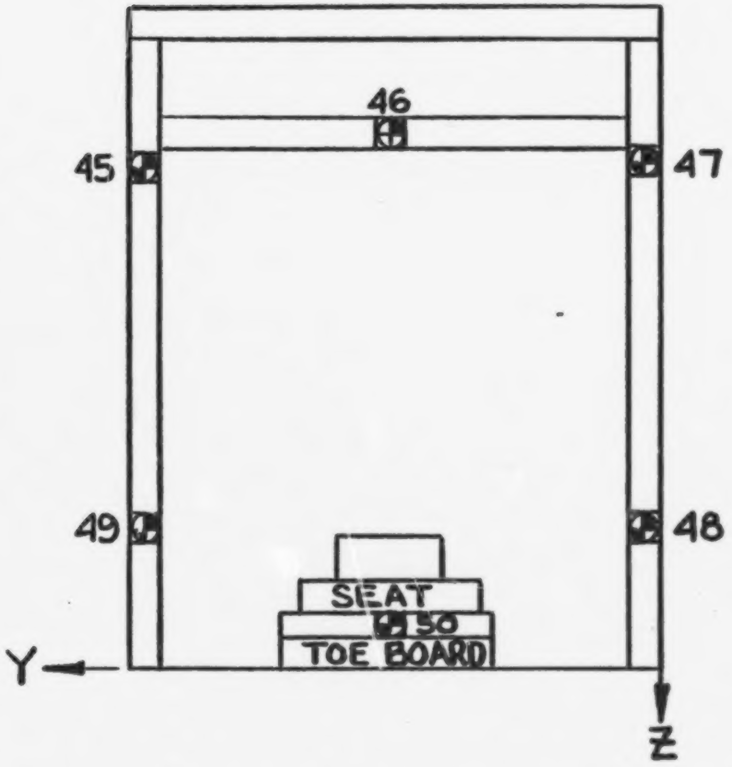

A/B PANEL
41
42
20
5
KNEE BAR
43
44
17a
3a
Y
Z

TARGET NO.	COORDINATES ~ IN. X	Y	Z
3a	52 3/16	36 1/2	-1
5	51 1/16	-18 5/16	-40 1/8
17a	53 1/4	10	-1 1/16
20	51 3/16	-1	-40 1/16
41	41	9 9/16	-48 3/8
42	40 1/2	37 1/2	-48 1/16
43	65 5/16	10	-14 11/16
44	65 3/8	37 3/16	-14 11/16

(f) VIEW LOOKING FORWARD FROM SEAT POSITION

Figure 14 (Cont'd.)

	COORDINATES ~ IN.		
TARGET NO.	X	Y	Z
45	5/16	45 5/16	-42 1/8
46	5/16	23 3/4	-45 3/4
47	5/16	2	-42
48	5/16	1 15/16	-12
49	5/16	45 1/4	-12 1/16
50	66 1/8	23 3/4	-8 1/2


46
45
47
49
48
SEAT
50
TOE BOARD
Y
Z

(g) FRONT CAMERA VIEW OF FIXED TARGETS ON BUCK.

Figure 14 (Cont'd.)

Other photographic coverage of the tests included two onboard Polaroid sequence cameras which enabled "quick look" review of the dummy kinematics and pre- and post-test still pictures showing the initial and final rest positions of the dummy.

3. TEST METHODOLOGY

The test program consisted of several preliminary sled runs without the dummy to check the operation of the instrumentation and other equipment, two runs (Nos. 2043 and 2047) also without the dummy, for measurement of the contact panel inertia (tare) loads that were subtracted from the data obtained in the tests with the dummy to determine the net dummy contact forces, three replicate tests of the air bag restraint configuration (Run Nos. 2044, 2045 and 2046) and three replicate tests of the belt restraint configuration (Run Nos. 2049, 2050 and 2051). The initial series of tests showed that contact panel loads were highly oscillatory due to vibration of the buck structure supporting the panel assemblies. Structural vibration effects were greatest for the air bag panel which was the most difficult to support rigidly because of its heavier weight and higher elevation on the sled. Sled runs performed after incorporating additional braces, gussets, etc. to make the structure more rigid indicated the vibration effects were reduced considerably and, though not entirely eliminated, were highly repeatable.

From the data of the preliminary tests, it was also discovered that the load cells themselves were sensitive to accelerations. However, since the sled acceleration pulse was the same for all tests, both with and without the dummy, it is believed that this sensitivity to acceleration as well as the effects of the structural vibrations did not greatly affect the accuracy of the dummy contact force measurements.

3.1 Air Bag Restraint Tests

The procedure for setup of the dummy in the buck was similar for all of the tests. The dummy was placed on the seat, which was covered with a teflon sheet to reduce friction, with the lower torso against the seat back. The legs were adjusted so the feet rested on the toeboard with approximately

4 inches of clearance between the ankles and 3 inches between the knees. The arms were positioned so the hands were opposite the thighs and so lower arm contact with the legs would be avoided. Since the seat back did not support the upper torso, a latch bar which engaged the photo target bracket on the back of the dummy was used to aid in positioning of the dummy. When the latch was removed, the upper torso moved rearward a small amount due to the slight initial contact of the dummy with the pre-inflated bag. For this reason, and also because joint friction (adjusted to 1 G) made it difficult to move one segment without affecting the position of other, previously aligned points, precise positioning of the dummy in the second and third replicate tests to match that of the first air bag run was virtually impossible. Handling of the dummy was also hampered by the presence of the many photographic targets attached to it. Measurements of the dummy initial position for each of the three tests of the air bag restraint configuration are presented in Figure 15.

The air bag was pre-inflated to a static pressure of 2 inches of water for each test. Prior to use, the balloon liners were stretched by inflating them to a diameter of approximately six feet for several hours as part of the liner selection and conditioning procedure that was aimed at insuring repeatability of rupture in the tests.

The dummy and sled-mounted hardware were thoroughly inspected for damage after each test. In addition to the balloon liner and styrofoam padding on the knee bolster which were replaced for each run, some of the photographic targets on the dummy were missing or damaged and required replacement.

A check of the accelerometers installed on the right lower arm of the dummy after the first test (Run 2044) revealed that all had been destroyed. It is believed that this might have been caused by contact of the hand with the knee bolster which produced accelerations that exceeded the 200 G range of the instruments.* Because of the danger of damaging these costly instruments, it was decided, after consulting with the sponsor, to eliminate

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*Similar contact of both hands occurred in the subsequent tests as evidenced by imprints of the fingers in the knee bolster padding.

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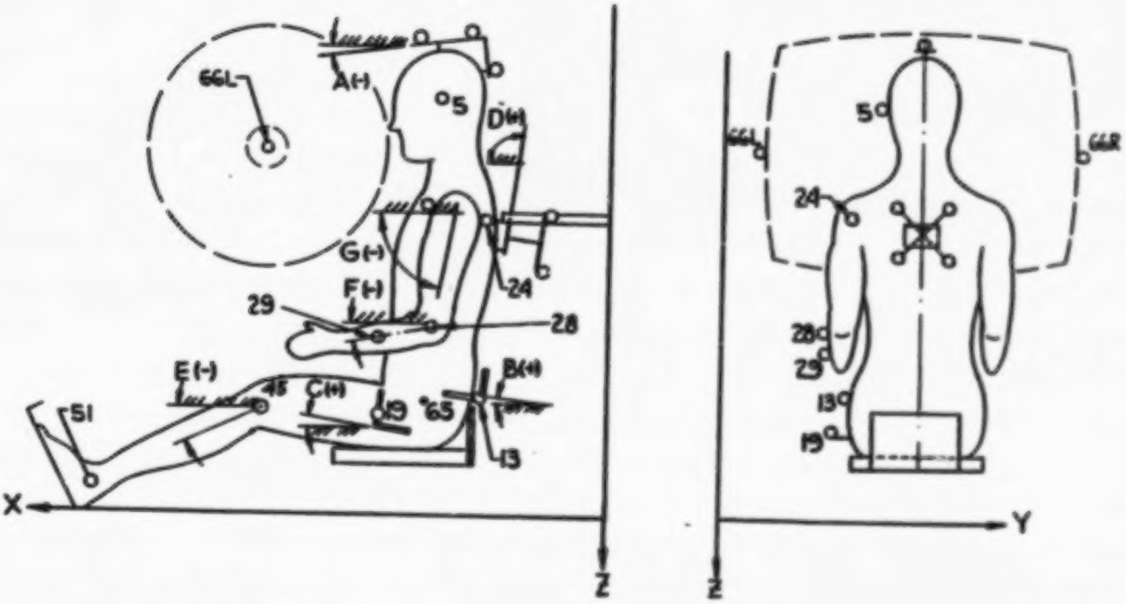


DUMMY REF POINTS	POINT NO.	TEST NO. 2044				TEST NO. 2045				TEST NO. 2046			
		COORDINATES (INCHES)			ANGLE (°)	COORDINATES (INCHES)			ANGLE (°)	COORDINATES (INCHES)			ANGLE (°)
		X	Y	Z		X	Y	Z		X	Y	Z	
LEFT EAR	5	23 1/8	19 11/16	37 9/16		21 15/16	19 13/16	37 1/4		22 3/16	20 1/4	37 1/4	
LOWER TORSO	13	18 1/8	16 3/4	13 5/16		18 13/16	17 3/8	13 5/16		18 1/16	17 3/16	13 7/16	
LEFT FEMUR	19	28	15 3/8	9 3/4		27 11/16	15 15/16	9 3/8		28 1/16	15 3/4	9 5/8	
LEFT SHOULDER	24	18 3/16	15 3/4	28 1/16		17 7/8	16	28 5/16		18	16 5/16	28 5/16	
LEFT ELBOW	28	21 1/16	12 1/8	18 1/2		20 1/4	13 3/8	18		20 5/16	13 1/4	17 3/4	
LEFT WRIST	29	26 5/16	14 7/16	16		26 1/8	14 3/8	15 3/8		26 3/8	14 1/2	15 3/8	
LEFT KNEE	45	40 1/16	17 1/16	11 13/16		39 3/4	17 5/16	10 3/8		39 11/16	17 7/16	11 1/16	
LEFT ANKLE	51	54	18 11/16	3 9/16		54 1/16	18 11/16	3 9/16		53 11/16	18 1/2	3 1/2	
HIP JOINT FLESH HOLE	65	24 3/8		10 3/8		24	17 5/16	10 3/8		24 1/16		10 7/16	
AIR BAG VENT CENTER:													
LEFT SIDE	66L	39 7/8	6 5/16	28 3/8		40 1/8	7 1/8	29 1/16		39 1/8		30 1/8	
RIGHT SIDE	66R	38 5/8	38 11/16	29 3/16		39 3/4	39 1/4	29 3/16		39 9/16		30 7/8	
HEAD PITCH ANGLE	A				-12°58'				-6°56'				-7° 20'
LOWER TORSO ANGLE	B				12°11'				2°46'				2°33'
UPPER LEG ANGLE	C				11° 4'				10°41'				10°48'
UP. TORSO TARGET R. ANGLE	D				93°58'				98°48'				98° 5'
LOWER LEG ANGLE	E				-27°35'				-27°28'				-27°28'
LOWER ARM ANGLE	F				-23°13'				-15° 1'				-21°35'
UPPER ARM ANGLE	G				-85°54'				-64°45'				-68°31'

Figure 15 DUMMY INITIAL POSITION MEASUREMENTS FOR AIR BAG RESTRAINT TESTS

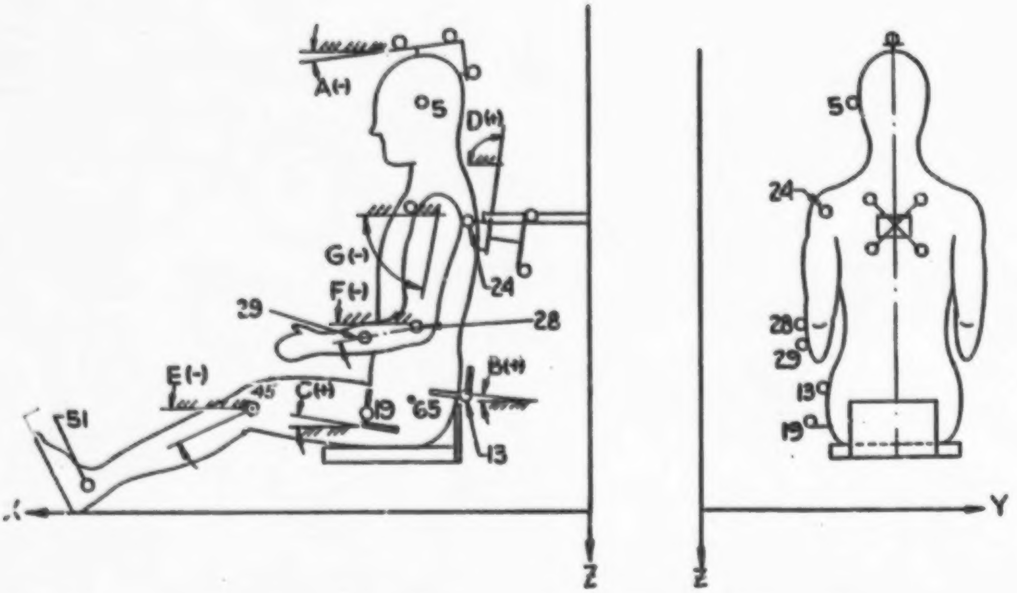
measurements of lower arm accelerations in the remaining two tests of the air bag restraint configuration.

The knee bolster contact panel also sustained some damage in the first test. The data indicate that yielding of the structure, which can be observed in the test films, occurred under the combined loads of about 6800 lb. normal and 2000 lb. tangential to the panel. The panel was repaired and reinforced for the other tests and, because of the added weight, another sled run (No. 2047) for measurement of the different tare load was performed.

3.2 Belt Restraint Tests

The dummy setup procedures for the belt restraint tests were similar to those described in the preceding section. Measurements of the initial position of the dummy for each of the three tests performed are given in Figure 16. The lap belt was adjusted to be snug on the lower torso with a preload of approximately 5 lb. The shoulder belt was adjusted to provide 3 inches of slack between the belt and dummy chest. The position of the shoulder belt for the first test was outlined on the dummy upper torso to insure the same placement of the belt for the succeeding tests.

Both lower arms were again instrumented with three orthogonal accelerometers. An unanticipated problem was encountered in the initial sled run when, as a result of twisting of the dummy toward the left due to loading by the shoulder belt, the left arm became partly restrained by the rebound safety cable described earlier. To avoid this interference in the later tests, a string of rubber bands was attached to the cable to pull it downward and to the side as the cable became slack during the forward movement of the dummy relative to the sled buck. (The slight initial tension in the cable affected the equilibrium position of the dummy and resulted in a 1.5 inch forward movement of the head when the upper torso positioning latch bar was removed.) This scheme appears to have worked satisfactorily in the second test but interference of the cable with the left arm of the dummy may be observed in the high speed films of the last sled run. Because the interferences



DUMMY REF POINTS	POINT NO.	TEST NO. 2049				TEST NO. 2050				TEST NO. 2051			
		COORDINATES (INCHES)			ANGLE (°)	COORDINATES (INCHES)			ANGLE (°)	COORDINATES (INCHES)			ANGLE (°)
		X	Y	Z		X	Y	Z		X	Y	Z	
LEFT EAR	5	24 5/8	20 5/16	37 1/8		24 3/8	20 15/16	37 1/8		24 11/16	21	37 1/16	
LOWER TORSO	13	18 1/8	17 1/16	13 3/8		17 7/8	17 7/16	13 7/16		17 13/16	17	13 1/8	
LEFT FEMUR	19	27 13/16	15 15/16	9 9/16		27 5/8	15 3/4	9 9/16		27 9/16	15 13/16	9 3/8	
LEFT SHOULDER	24	19 1/8	16 7/16	28 3/16		19 1/8	16 7/8	27 3/4		19 3/8	16 11/16	28 5/8	
LEFT ELBOW	28	23 3/4	13 9/16	18 3/4		23 9/16	13 13/16	18 3/16		23 9/16	13 5/8	19	
LEFT WRIST	29	29 3/8	14 1/2	15 13/16		29 1/4	14 1/8	15 13/16		29	13 7/8	16 1/8	
LEFT KNEE	45	39 13/16	17 15/16	11 1/2		39 5/8	17 7/8	11 5/16		39 9/16	17 5/8	11 3/8	
LEFT ANKLE	51	53 13/16	19	3 1/2		53 15/16	18 7/8	3 7/16		53 3/4	18 13/16	3 5/16	
HIP JOINT FLESH HOLE	65	24 3/16											
HEAD PITCH ANGLE	A				-15°30'				-15°30'				-16° 5'
LOWER TORSO ANGLE	B				3°24'				3°31'				5°10'
UPPER LEG ANGLE	C				10° 7'				9°26'				10°34'
UP. TORSO TARGET R. ANGLE	D				91°42'				91°20'				90° 7'
LOWER LEG ANGLE	E				-27°32'				-26°23'				-26°58'
LOWER ARM ANGLE	F				-29° 5'				-23° 6'				-28° 7'
UPPER ARM ANGLE	G				-76°54'				-80°41'				-83° 6'

Figure 16 DUMMY INITIAL POSITION MEASUREMENTS FOR BELT RESTRAINT TESTS

occurred late in the tests, there was no effect on the arm responses during most, if not all, of the 300 millisecond period for which time history data are presented herein.

New belts and load limiter hardware were used for each test and the length of various parts of the restraint system was measured after positioning of the dummy. These data, together with post-test measurements of the load limiter rods for determining the rod stroke distances, were shown earlier in Figure 7.

3.3 Data Reduction

The amplified signals from all of the electronic transducers on the dummy, sled buck and restraint system were recorded on 3 FM magnetic tape recorders. The analog data from each test were initially displayed on a multi-channel strip chart record for "quick-look" review. Subsequently, the tape records were read into Calspan's Digital Data Acquisition System (DDAS) which was used to digitize and process the data and to provide the time history plots contained in the appendices. Data processing accomplished by the DDAS included filtering in accordance with SAE Recommended Practice J211a channel class requirements and computation of resultant accelerations, the value of the Head Injury Criterion (HIC), the sum of the three load cells measuring the normal force on each contact panel, and the net panel contact loads obtained by subtracting the forces recorded in the tare sled runs from those measured in the replicate tests with the dummy.

4. SUMMARY OF TEST RESULTS

Results from the tests of the air bag restraint configuration are summarized in Table 3 where the peak values of the various responses measured in each replicate test are listed for comparison. Using the coefficient of variation as the measure of response repeatability, the seat tangential force (0.527 coefficient of variation) is the parameter for which the maximum value varied most widely in the tests. Analysis of the seat net tangential force data plots shows that the peak value in both sled runs 2045 and 2046 resulted from a "spike" at approximately 80 msec. that did not occur in test 2044. It is possible that the yielding of the knee bolster observed in test 2044 at very nearly that time could account for the small difference of response.

The next largest coefficient of variation (0.258) is indicated by the results for the head injury criterion (HIC). The time histories of the head resultant acceleration from the tests are overlaid for comparison in Figure 17. Although the accelerations recorded in test 2044 were substantially lower than in the other two tests and therefore resulted in a lower HIC value, the close match of the detailed shape of the responses is clearly evident. The overlay of the chest resultant acceleration time histories presented in Figure 18 likewise shows close agreement of the responses.

Results from the belt restraint tests are similarly summarized for comparison in Table 4. In these tests the coefficient of variation is greatest for the stroke of the shoulder belt load limiter (0.768), followed by those computed for the peak resultant accelerations for the left and right arms (0.470 and 0.206, respectively). As may be noted in Table 4 (and Figure 7), the stroke of the load limiter at the upper anchor point was very small in the last test compared to that measured in the other sled runs.

Table 3

SUMMARY OF RESULTS FROM AIR BAG RESTRAINT TESTS

Measurement	Sled Run No. 2044	2045	2046
Contact Panel Net Normal Load ~ Lb.			
Seat	3375	3150	3750
Toeboard	875	875	950
Knee Bolster	6400	6050	6400
Air Bag Reaction Panel	2975	2875	2850
Contact Panel Net Tangential Load ~ Lb.			
Seat(1)	(-)150 (1725)	(-)350 (1450)	(-)500 (1680)
Toeboard	(-)440	(-)530	(-)510
Knee Bolster	1875	2325	2300
Air Bag Reaction Panel	(-)1200	(-)1040	(-)1100
Air Bag Pressure ~ Psig	4.2	4.6	4.1
Head Resultant Accel. ~ G	69	85	88
HIC	680	1114	1109
Chest Resultant Accel. ~ G	61	71	74
Chest Severity Index (300 msec.)	480	590	615
Pelvis Resultant Accel. ~ G	81	66	88
Left Femur Load ~ Lb.	2200	2160	2450
Right Femur Load ~ Lb.	2375	2180	2210

(1) Values in ( ) from dummy rebound against seat back.

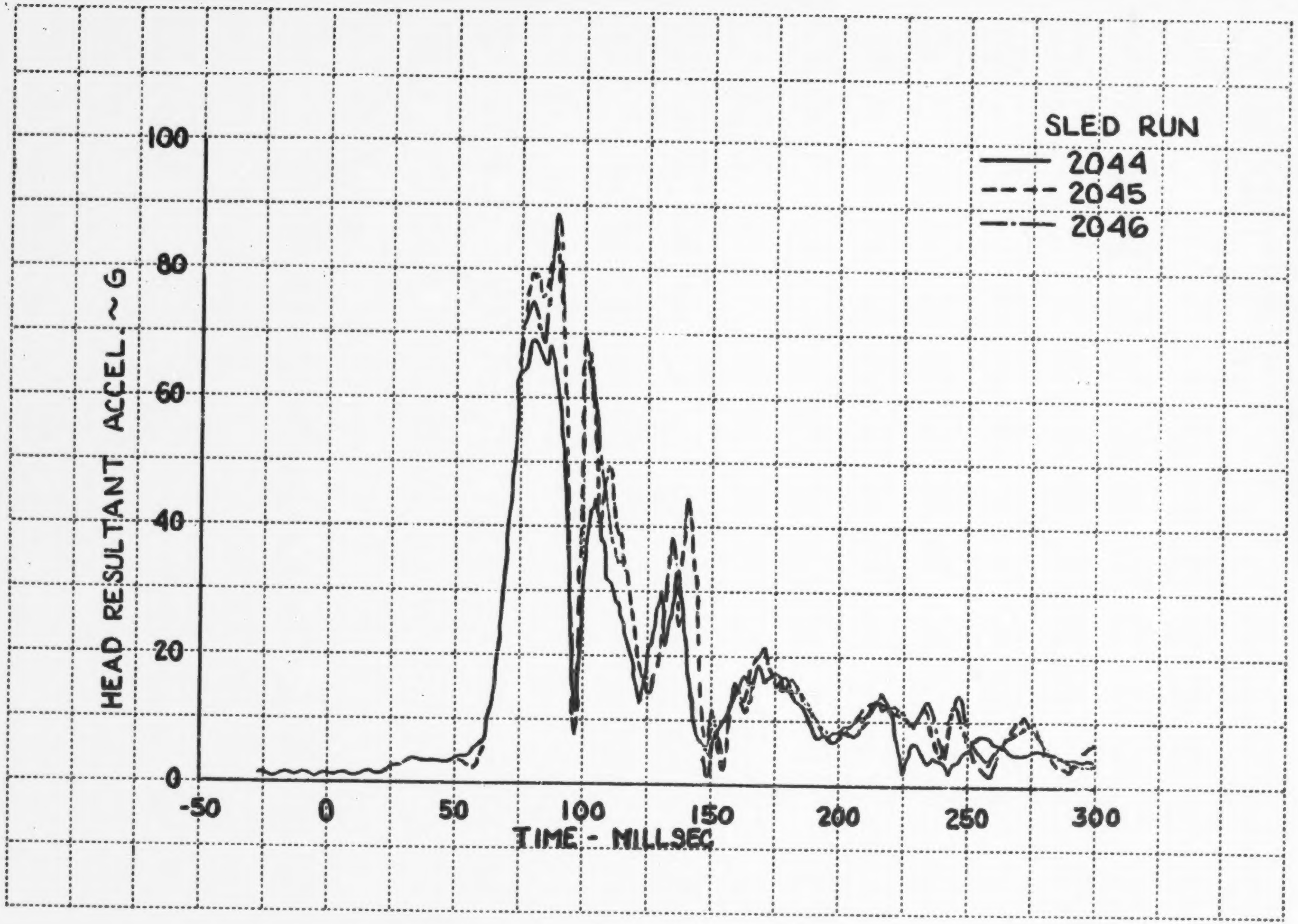


Figure 17 COMPARISON OF HEAD RESULTANT ACCELERATION RESPONSES IN AIR BAG RESTRAINT TESTS

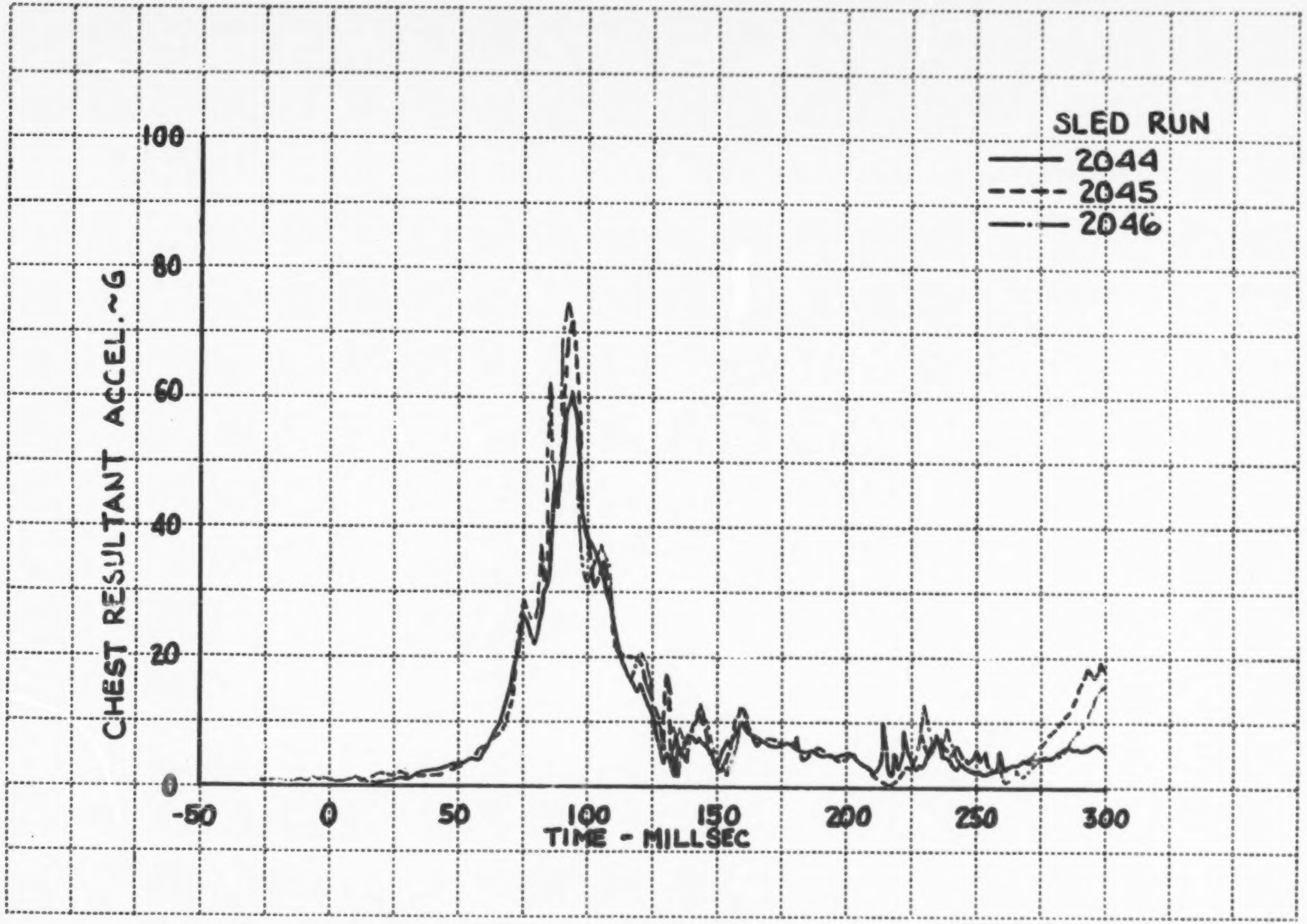


Figure 18 COMPARISON OF CHEST RESULTANT ACCELERATION RESPONSES IN AIR BAG RESTRAINT TESTS

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Table 4

SUMMARY OF RESULTS FROM BELT RESTRAINT TESTS

		Sled Run No.	
Measurement	**2049**	**2050**	**2051**
Contact Panel Net Normal Load ~ Lb.			
Seat	1390	1420	1030
Toeboard	910	990	1125
Contact Panel Net Tangential Load ~ Lb			
Seat(1)	(-)400 (1900)	(-)425 (2160)	(-)400 (2300)
Toeboard	(-)440	(-)475	(-)460
Belt Anchor Load ~ Lb.			
Left Lap	1725	1570	1500
Right Lap	1975	1975	1950
Shoulder	1800	1800	1875
Head Resultant Accel. ~ G	42	42	41
HIC	216	251	267
Chest Resultant Accel. ~ G	32	33	37
Chest Severity Index (300 msec.)	200	170	200
Pelvis Resultant Accel. ~ G	44	41	39
Left Arm Resultant Accel. ~ G	63	156	88
Right Arm Resultant Accel. ~ G	110	74	85
Lap Belt Elongation (2) ~ in.	6.7	6.5	6.6
Shoulder Belt Elongation (3) ~ in.	6.3	7.0	5.3
Left Lap Belt Load Limiter Stroke ~ in.	1.6	1.7	2.3
Right Lap Belt Load Limiter Stroke ~ in.	1.5	1.4	1.1
Shoulder Belt Load Limiter Stroke ~ in.	1.2	1.3	0.1

(1) Values in ( ) from dummy rebound against seat back.

(2) Includes left load limiter stroke.

(3) Includes upper load limiter stroke.

The time histories of the head and chest resultant accelerations measured in the belt restraint tests are shown for comparison in Figures 19 and 20, respectively. It may be noted that maximums of both the head and chest accelerations of test 2051 occurred later than in the other two tests. Again, however, the close correspondence of the responses recorded in replicate tests is clearly evident.

Based on the comparisons discussed above and the cursory review of other data which show that the measurements from replicate tests of each restraint configuration are similar, it is concluded that confidence in the validity of the test results is justified.

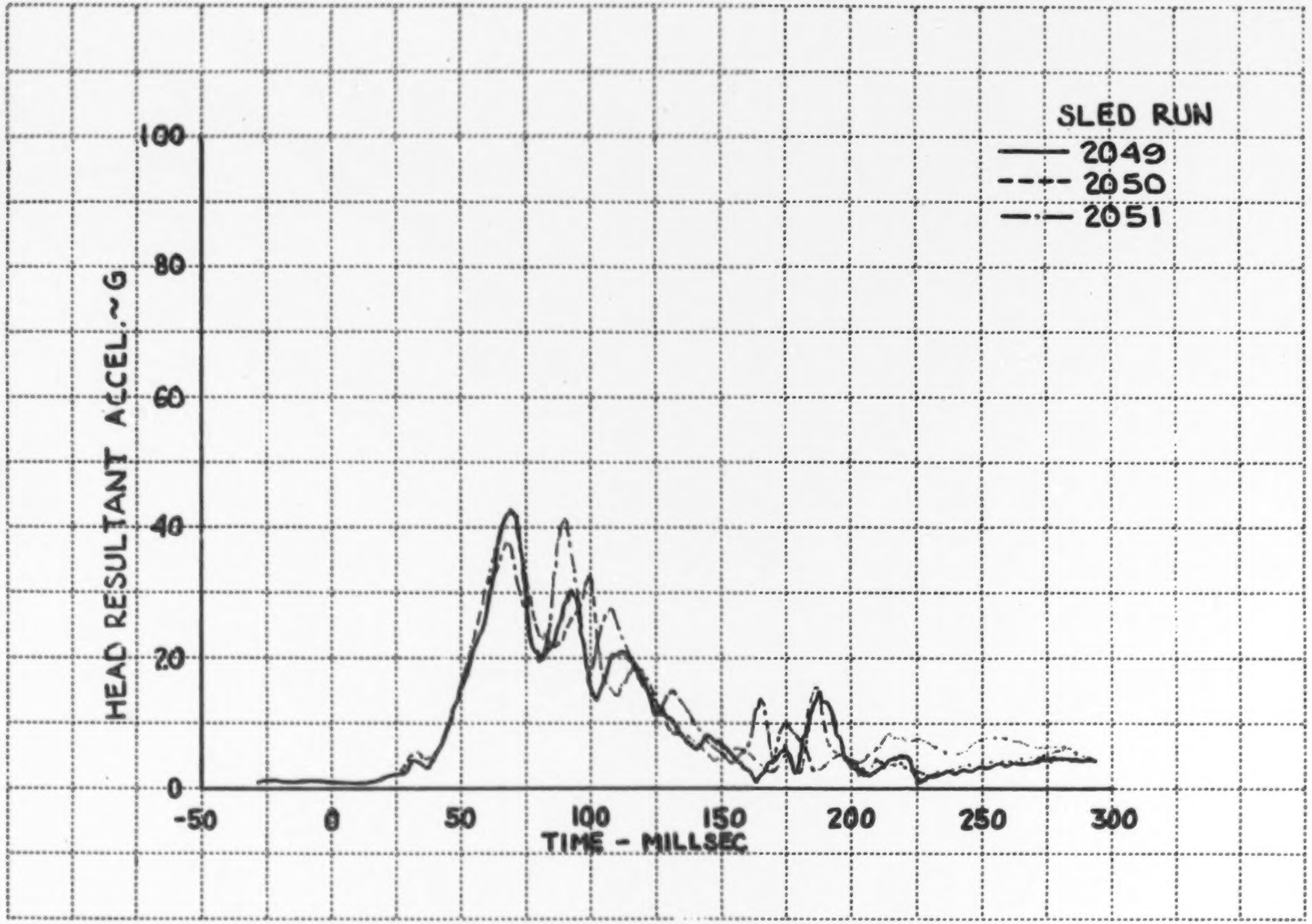

Figure 19 COMPARISON OF HEAD RESULTANT ACCELERATION RESPONSES IN BELT RESTRAINT TESTS

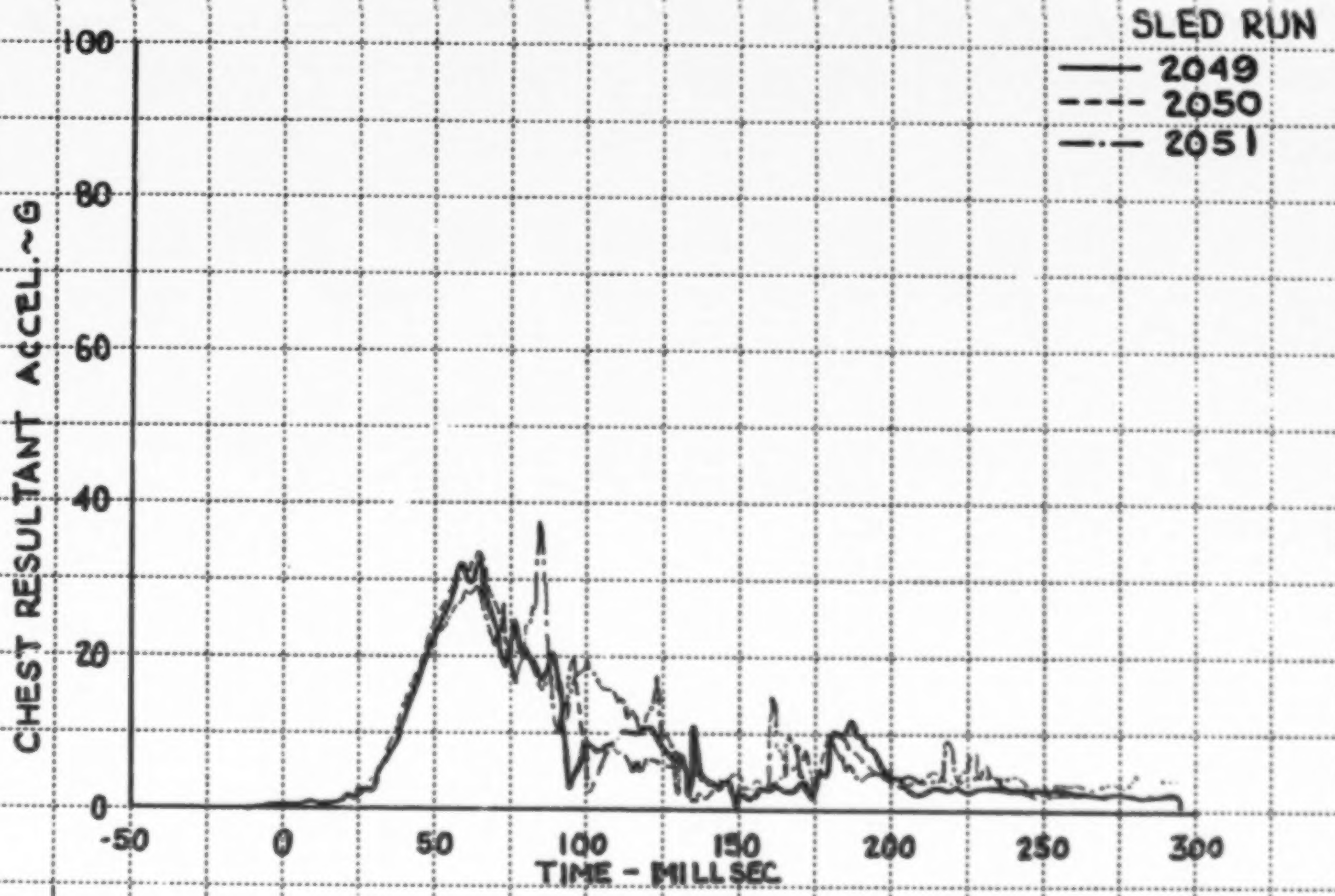

Figure 20 COMPARISON OF CHEST RESULTANT ACCELERATION RESPONSES IN BELT RESTRAINT TESTS

5. REFERENCES

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3. Fleck, J. T., Butler, F. E. and Vogel, S. L., "An Improved Three-Dimensional Computer Simulation of Motor Vehicle Crash Victims," (4 Volumes), Report Nos. DOT-HS-801-507 to -510, July 1974.

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7. Massing, D. E., Naab, K. N. and Yates, P. E., "Performance Evaluation of New Generation 50th Percentile Anthropomorphic Test Devices," Report No. DOT-HS-801431, November 1974.

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9. Padgaonkar, A. J., Krieger, K. W., and King, A. I., "Measurement of Angular Acceleration of a Rigid Body Using Linear Accelerometers," Journal of Applied Mechanics, Vol. 42, No. 3, 1975, pp. 552-556.

APPENDIX A

SLED TEST 2043 DATA RECORDS
(TARES FOR AIR BAG TEST NO. 2044)

Measurement	Filter Channel Class
Loads	60
Sled Acceleration	60

Sequence of Data Records

Seat Normal Load - Front Left, Front Right, Rear, Sum

Seat Tangential Load

Toeboard Normal Load - Lower Left, Lower Right, Upper Center, Sum

Toeboard Tangential Load

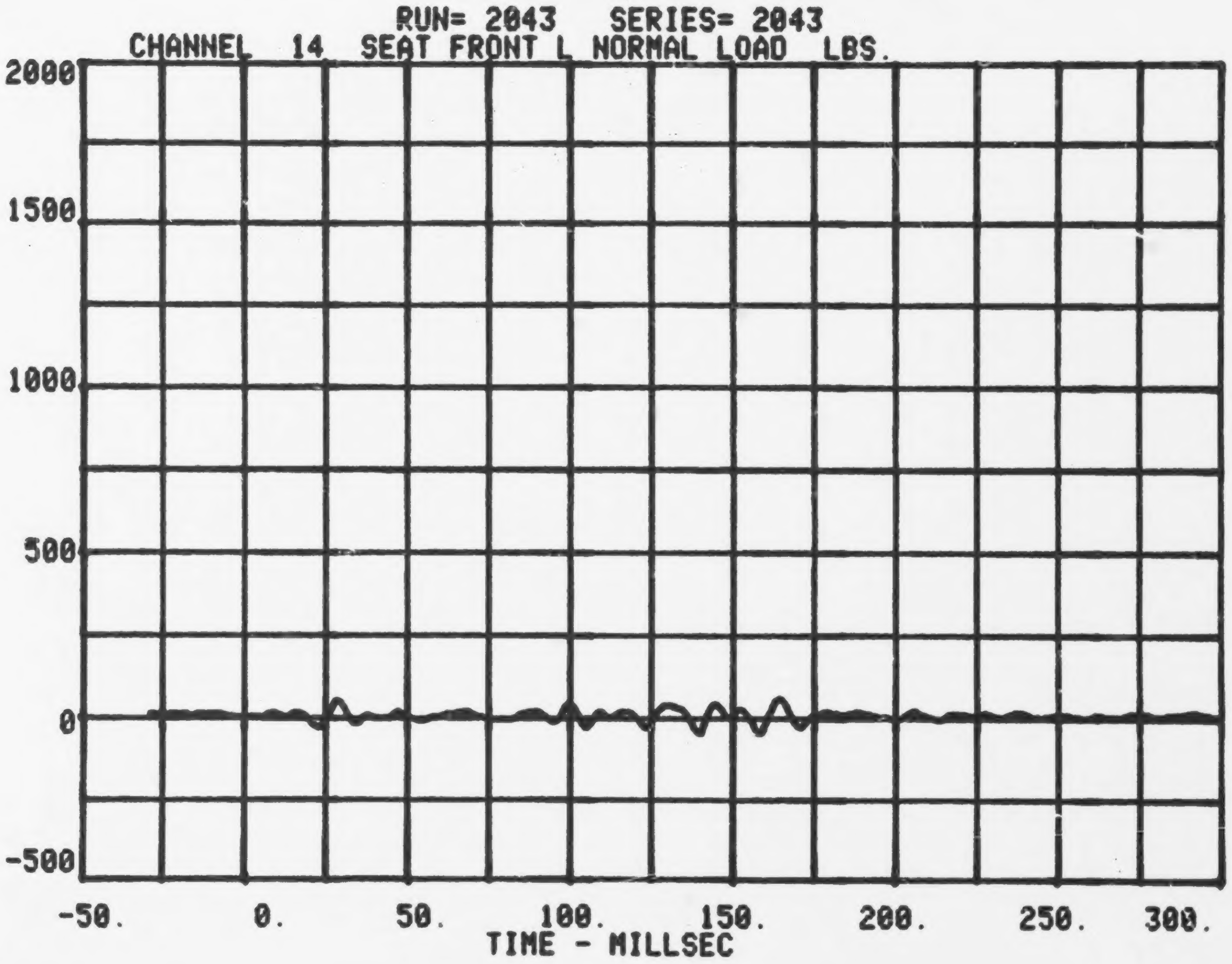
Knee Bolster Normal Load - Top Left, Top Right, Lower Center, Sum

Knee Bolster Tangential Load

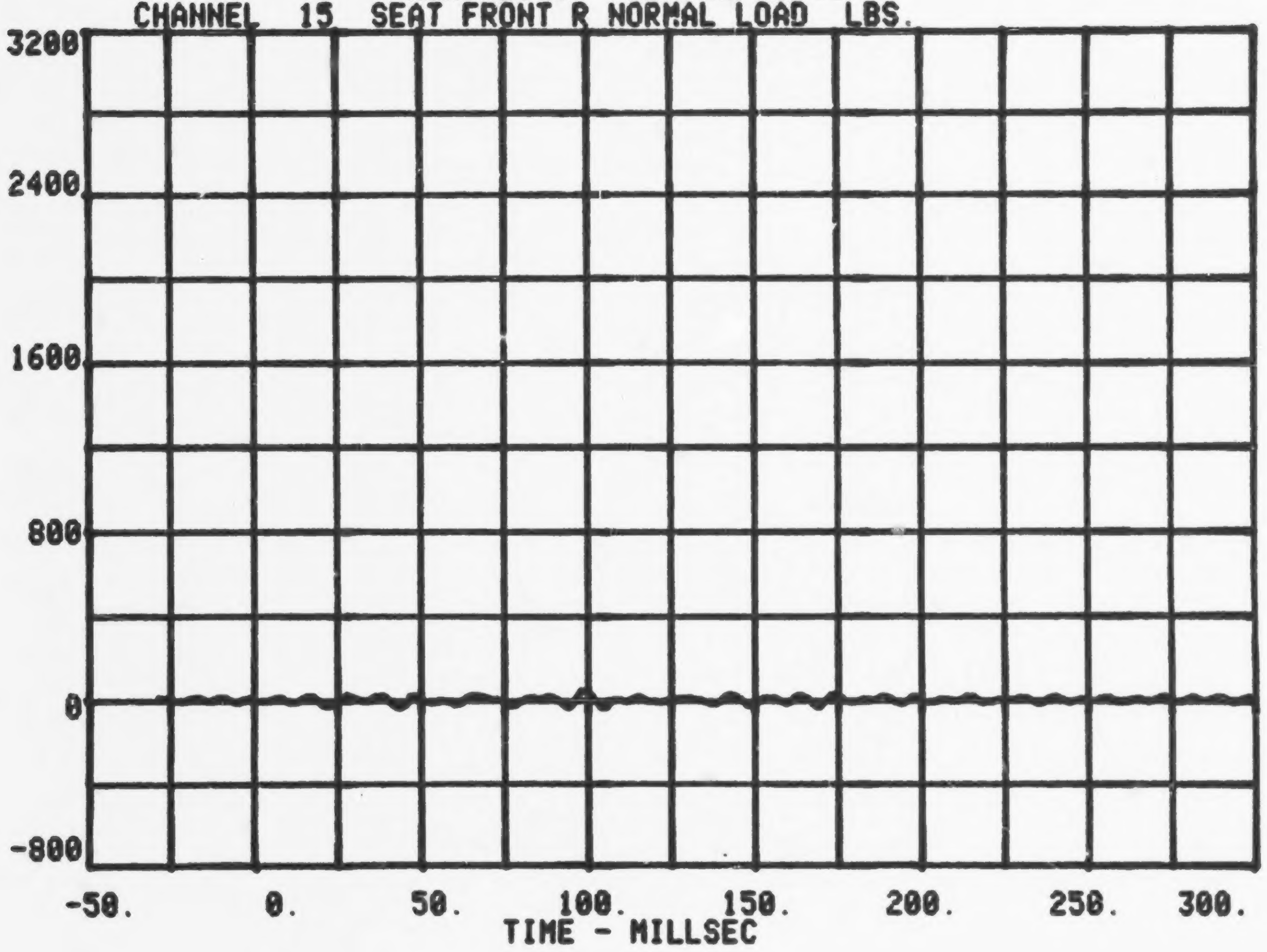
Air Bag Panel Normal Load - Lower Left, Lower Right, Top, Sum

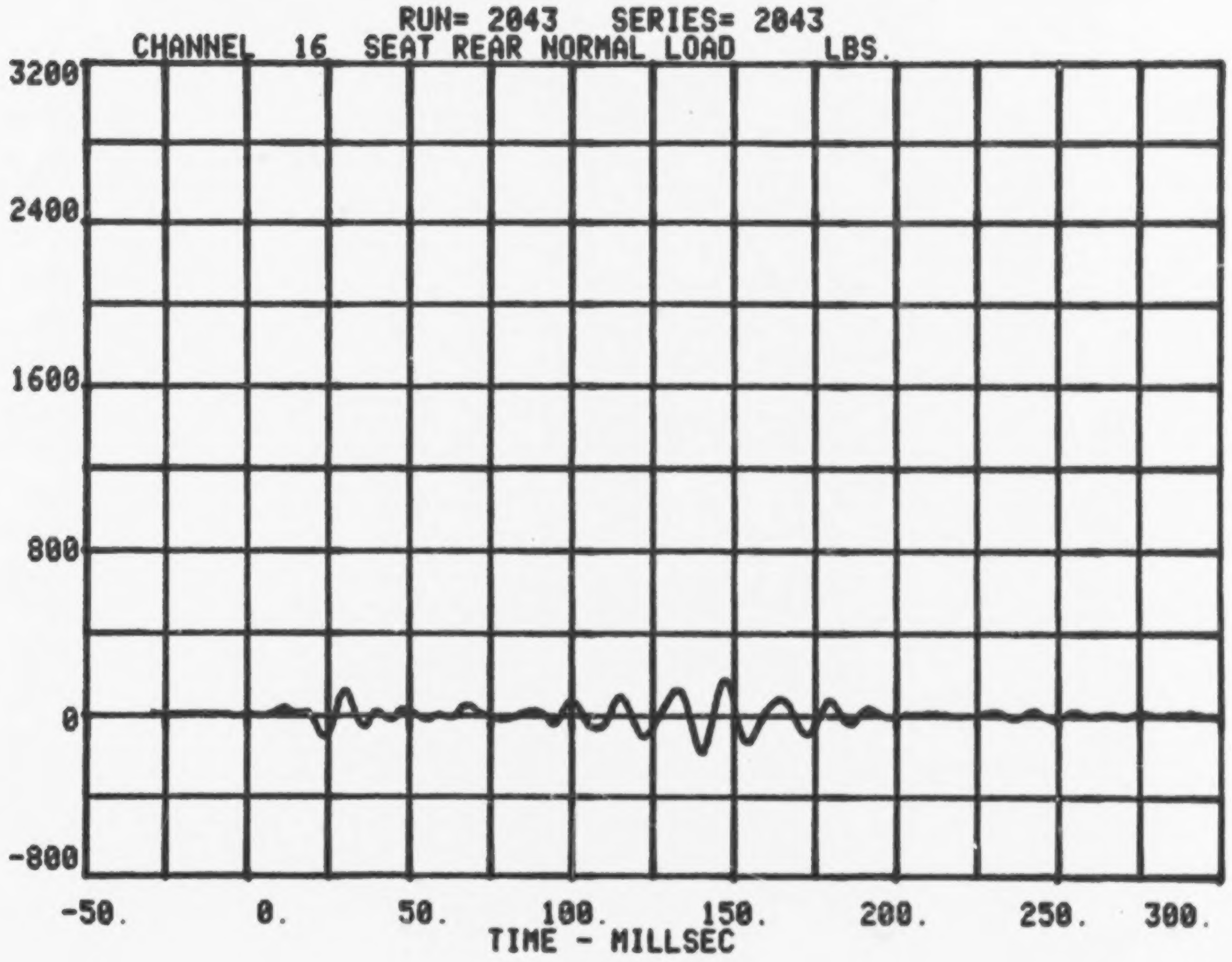
Air Bag Panel Tangential Load

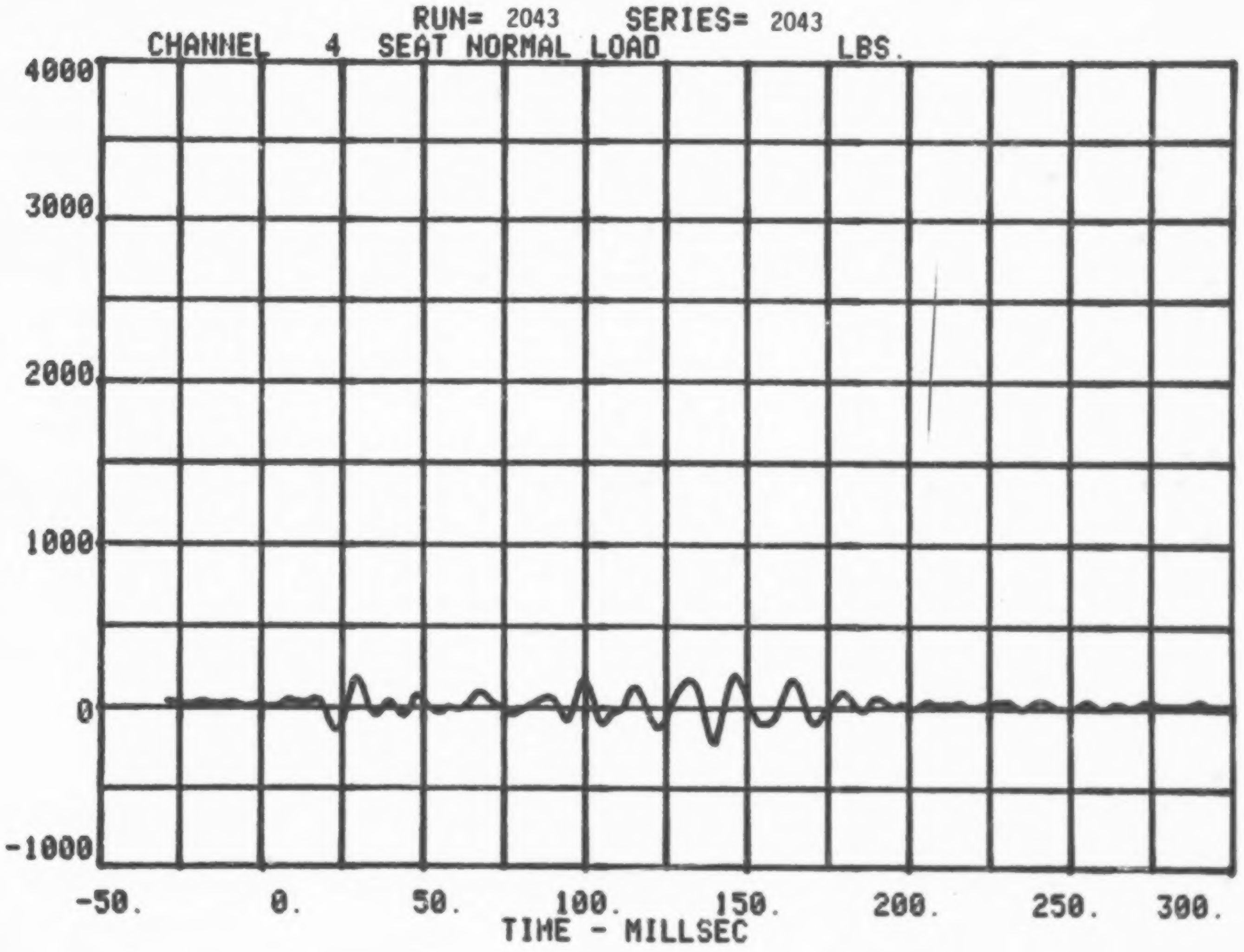
Sled Acceleration

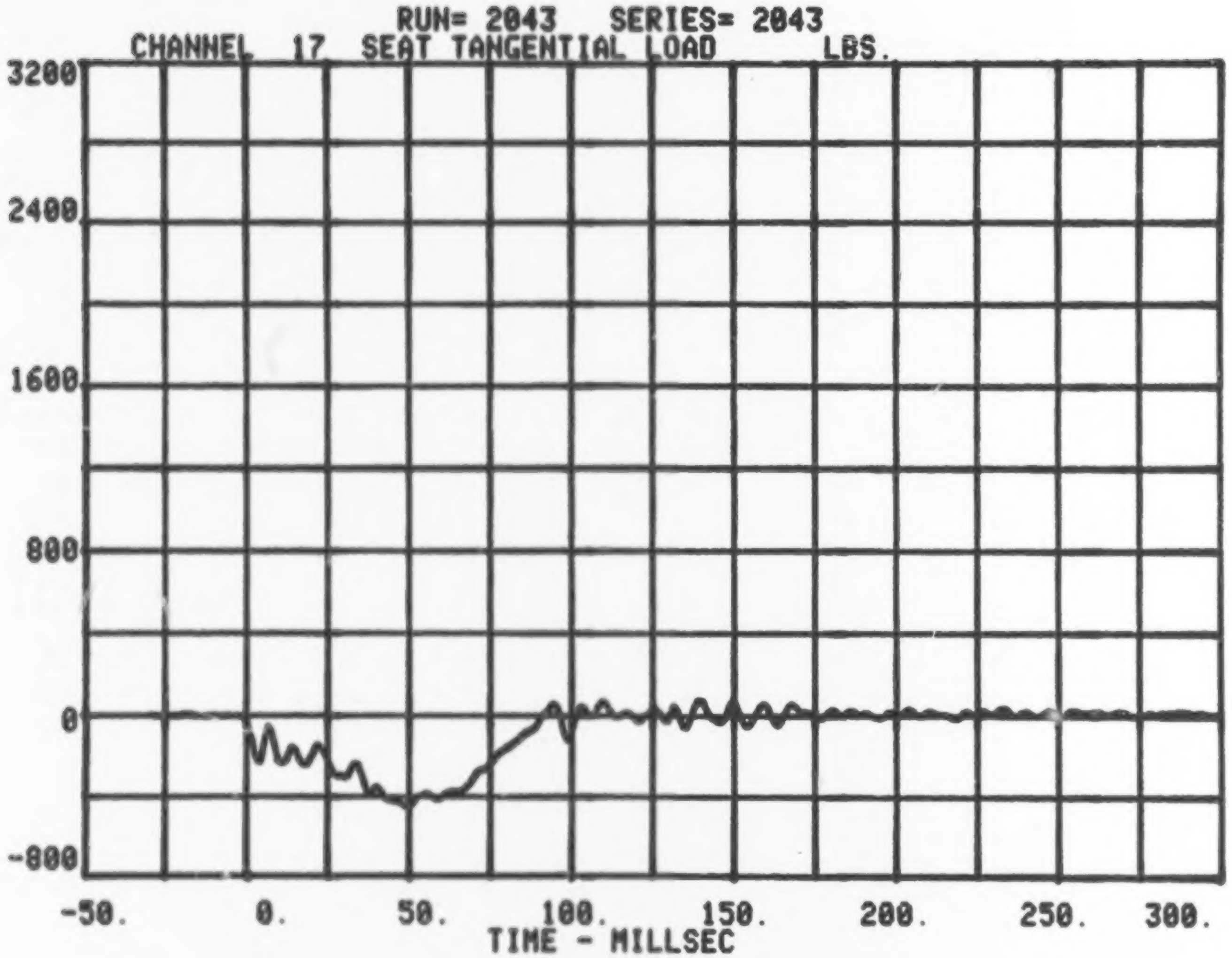

RUN= 2043 SERIES= 2043
CHANNEL 14 SEAT FRONT L NORMAL LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

RUN= 2043 SERIES= 2043
CHANNEL 15 SEAT FRONT R NORMAL LOAD LBS.

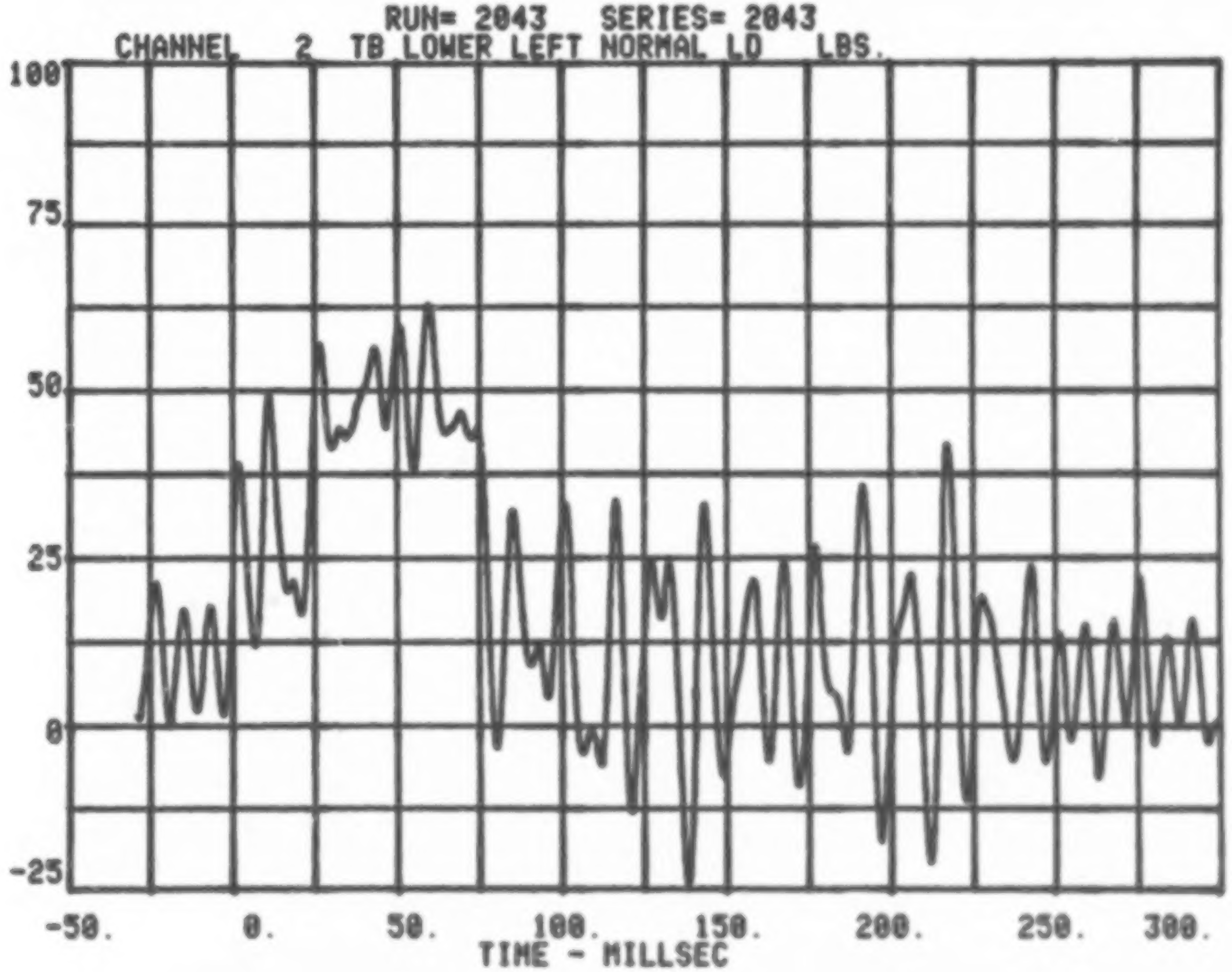


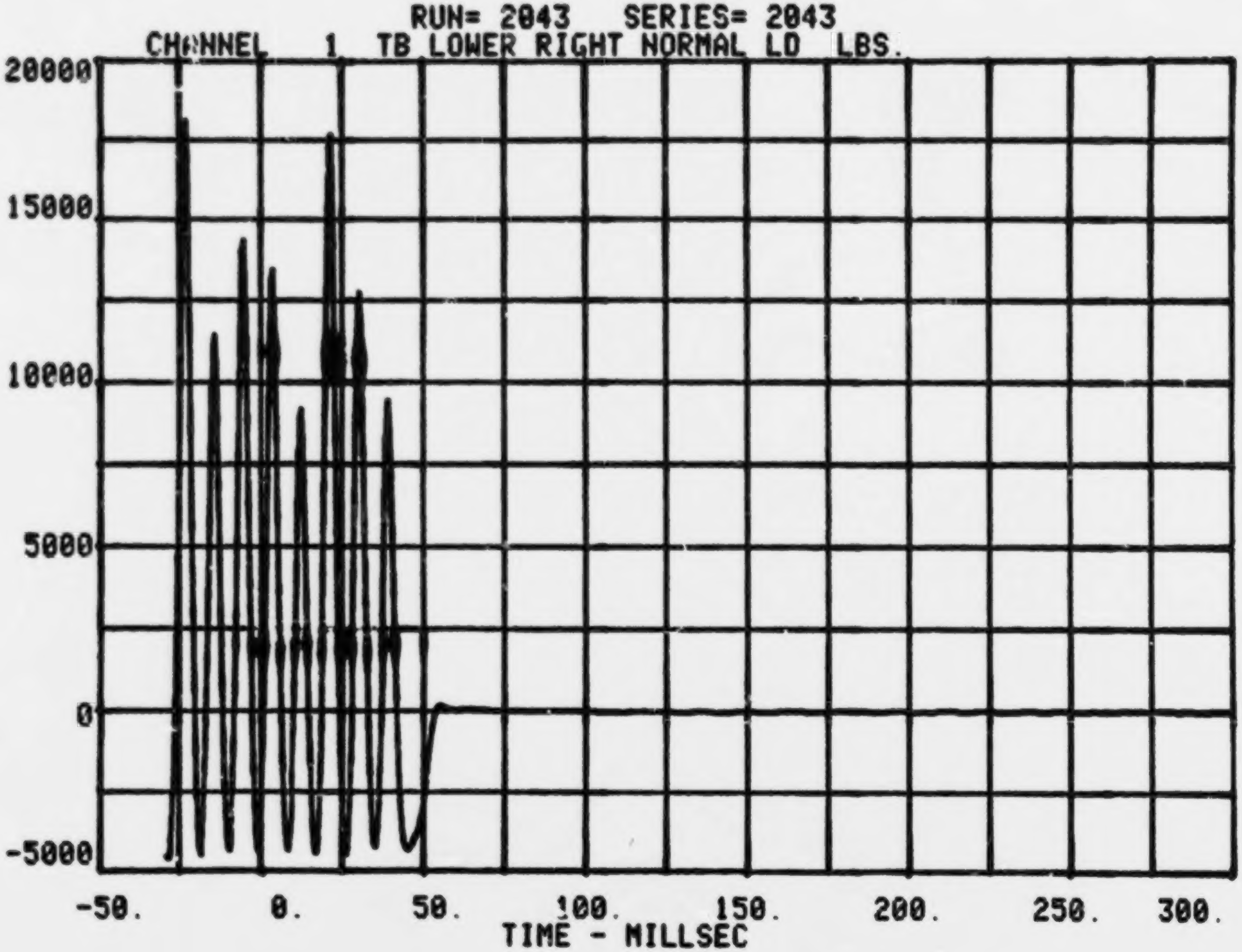

RUN= 2043 SERIES= 2043
CHANNEL 16 SEAT REAR NORMAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

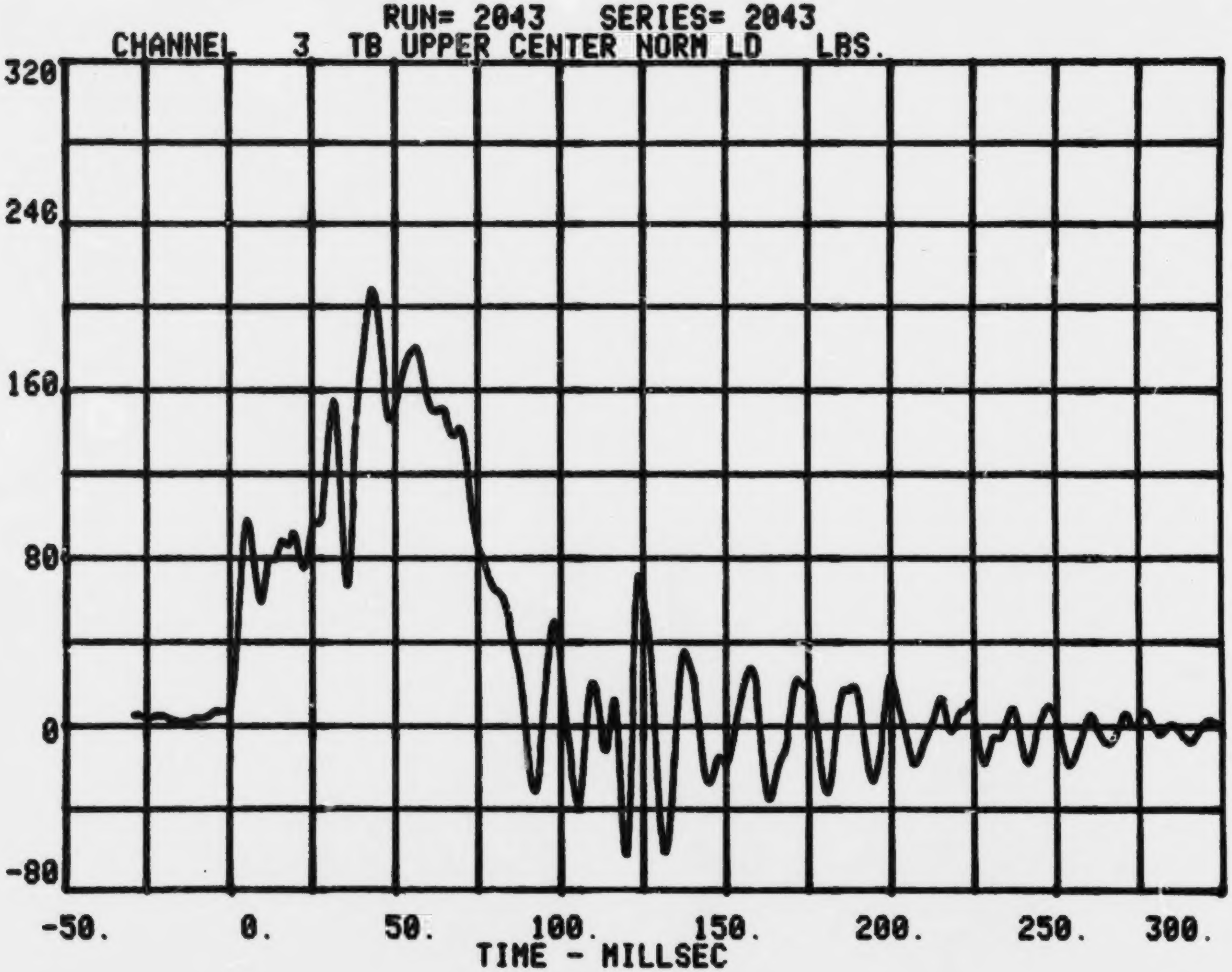

RUN= 2043 SERIES= 2043
CHANNEL 4 SEAT NORMAL LOAD LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

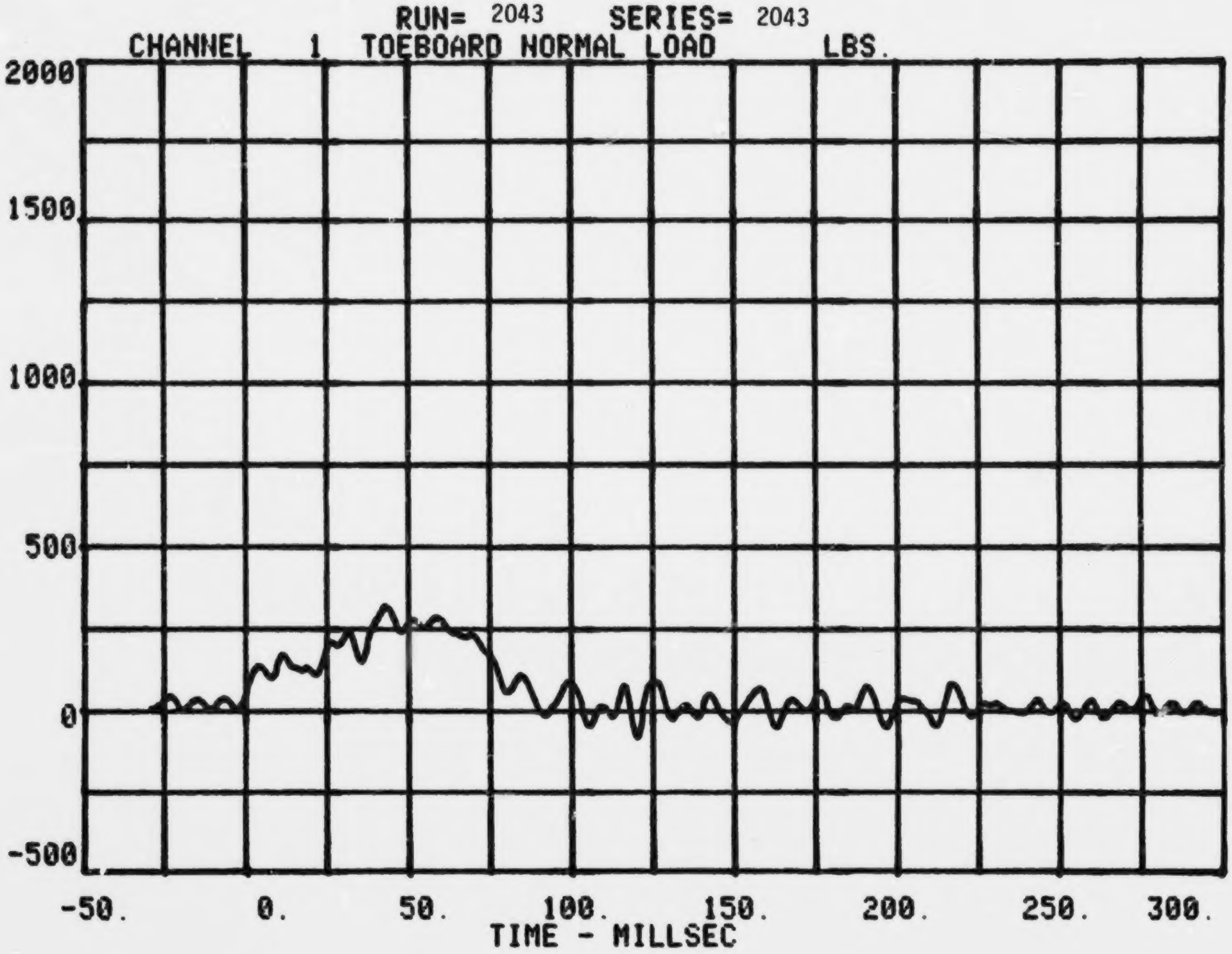


BEST DOCUMENT AVAILABLE

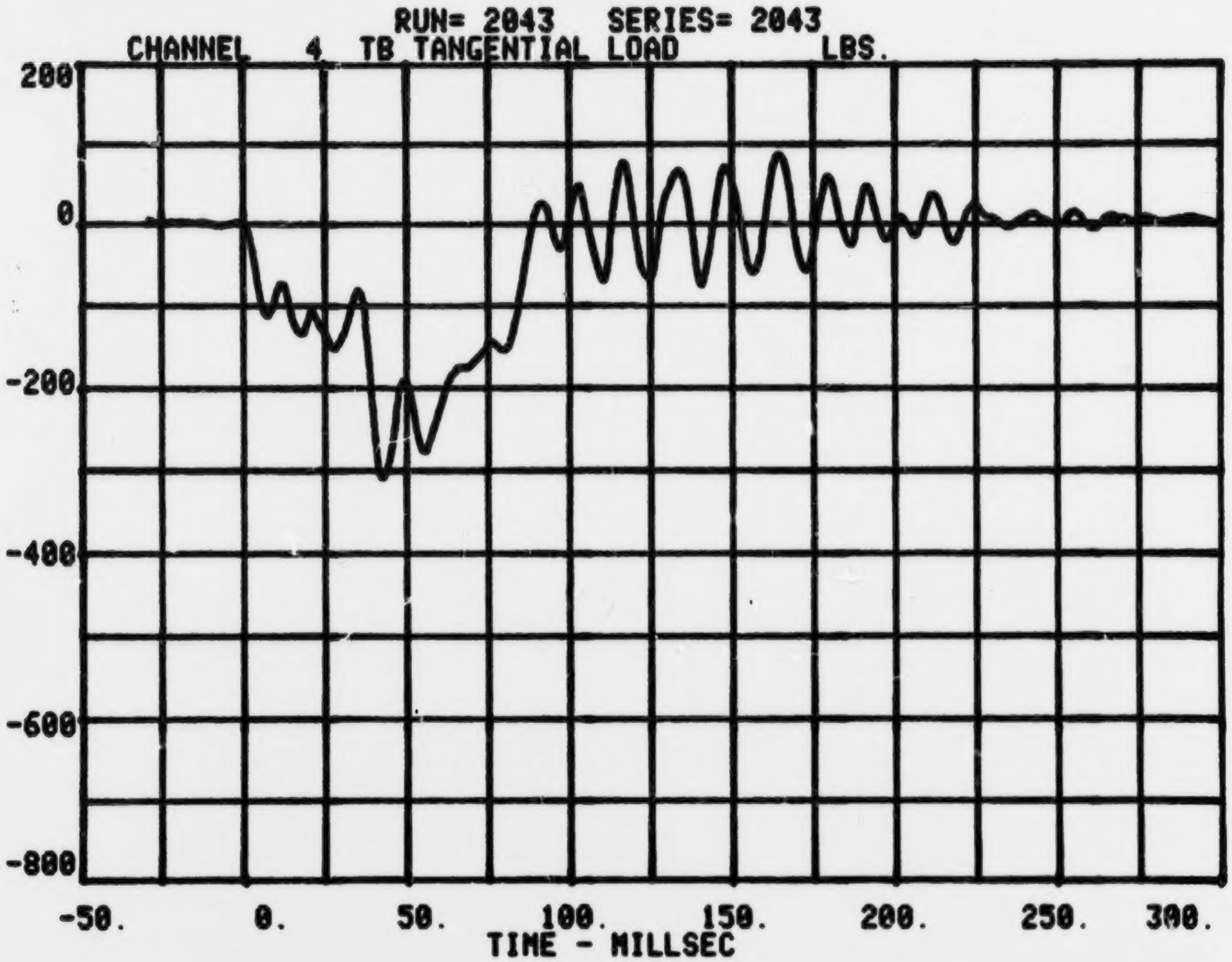

RUN= 2043 SERIES= 2043
CHANNEL 2 TB LOWER LEFT NORMAL LD LBS.
100
75
50
25
0
-25
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2043 SERIES= 2043
CHANNEL 1 TB LOWER RIGHT NORMAL LD LBS.
20000
15000.
10000.
5000
0
-5000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

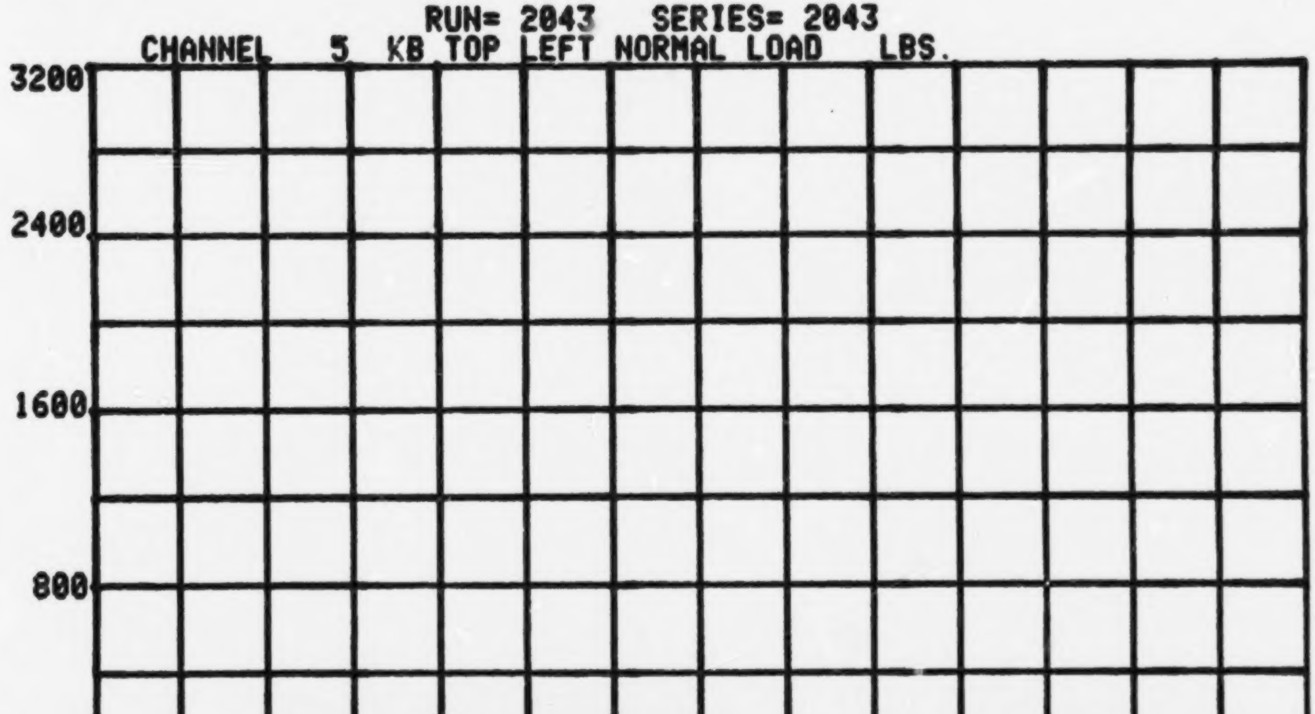

RUN= 2043 SERIES= 2043
CHANNEL 3 TB UPPER CENTER NORM LD LBS.
320
240
160
80
0
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

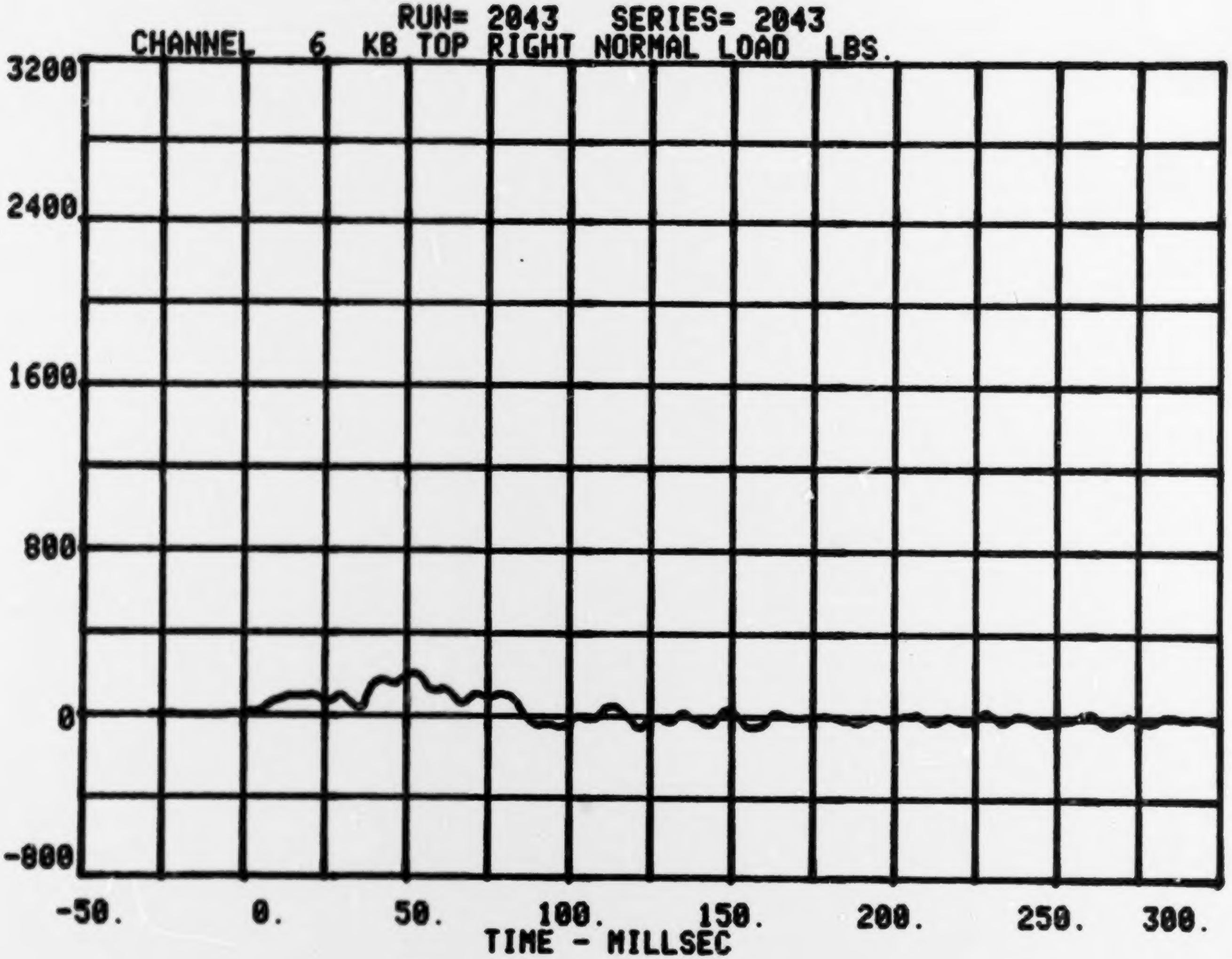


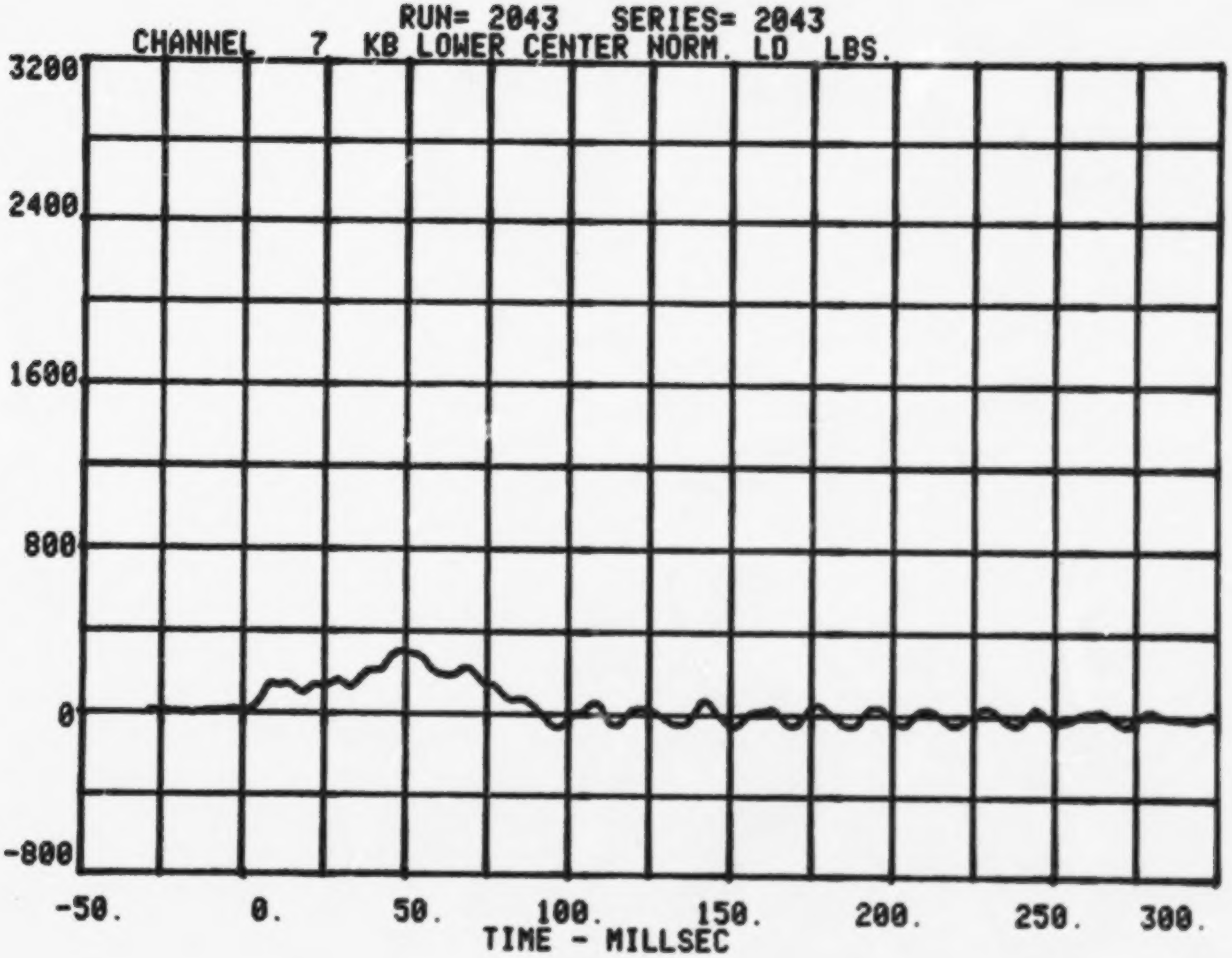
BEST DOCUMENT AVAILABLE



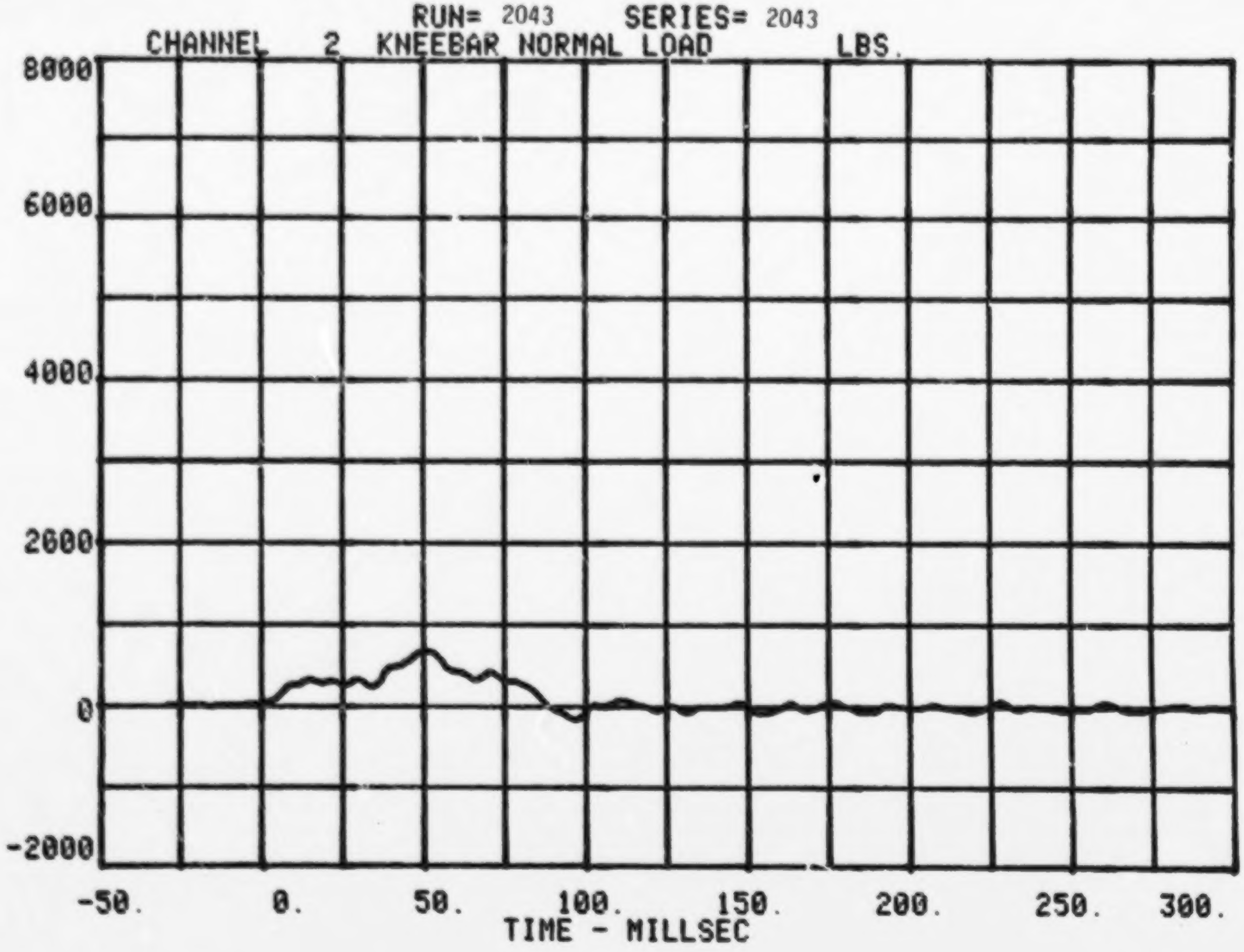
BEST DOCUMENT AVAILABLE

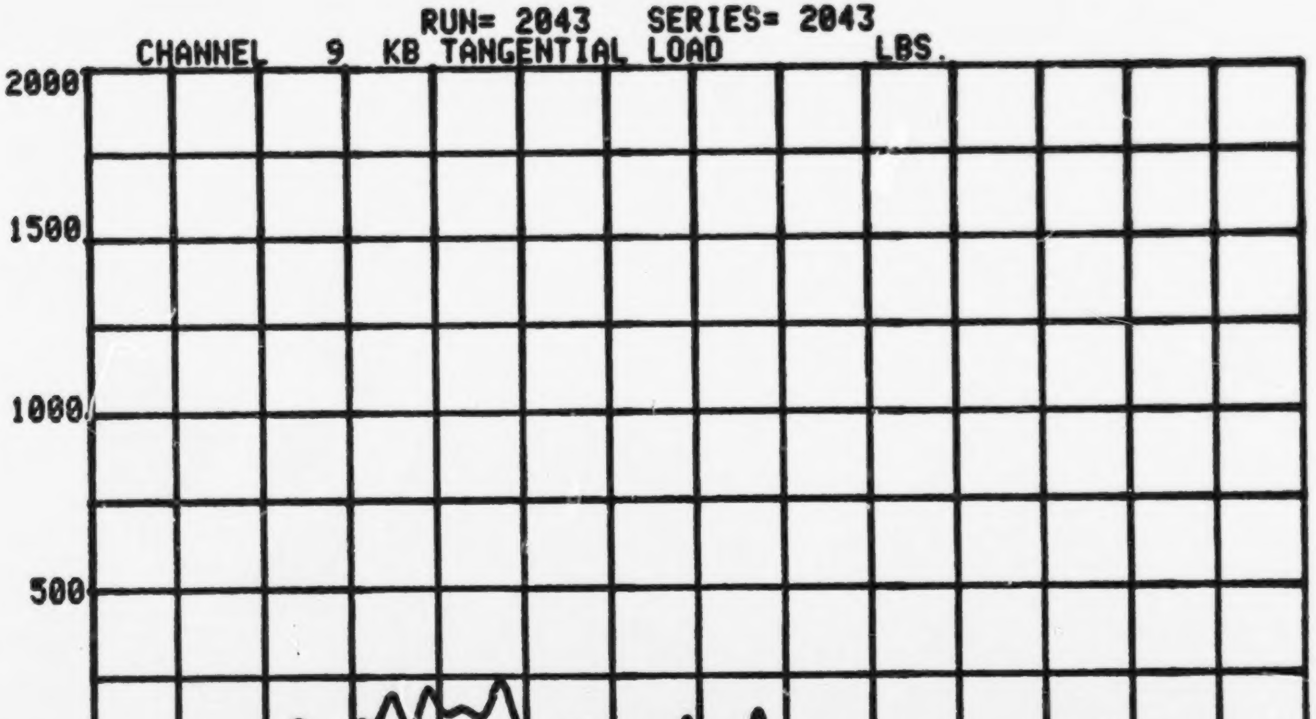

RUN= 2043 SERIES= 2043
CHANNEL 5 KB TOP LEFT NORMAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2043 SERIES= 2043
CHANNEL 6 KB TOP RIGHT NORMAL LOAD LBS.

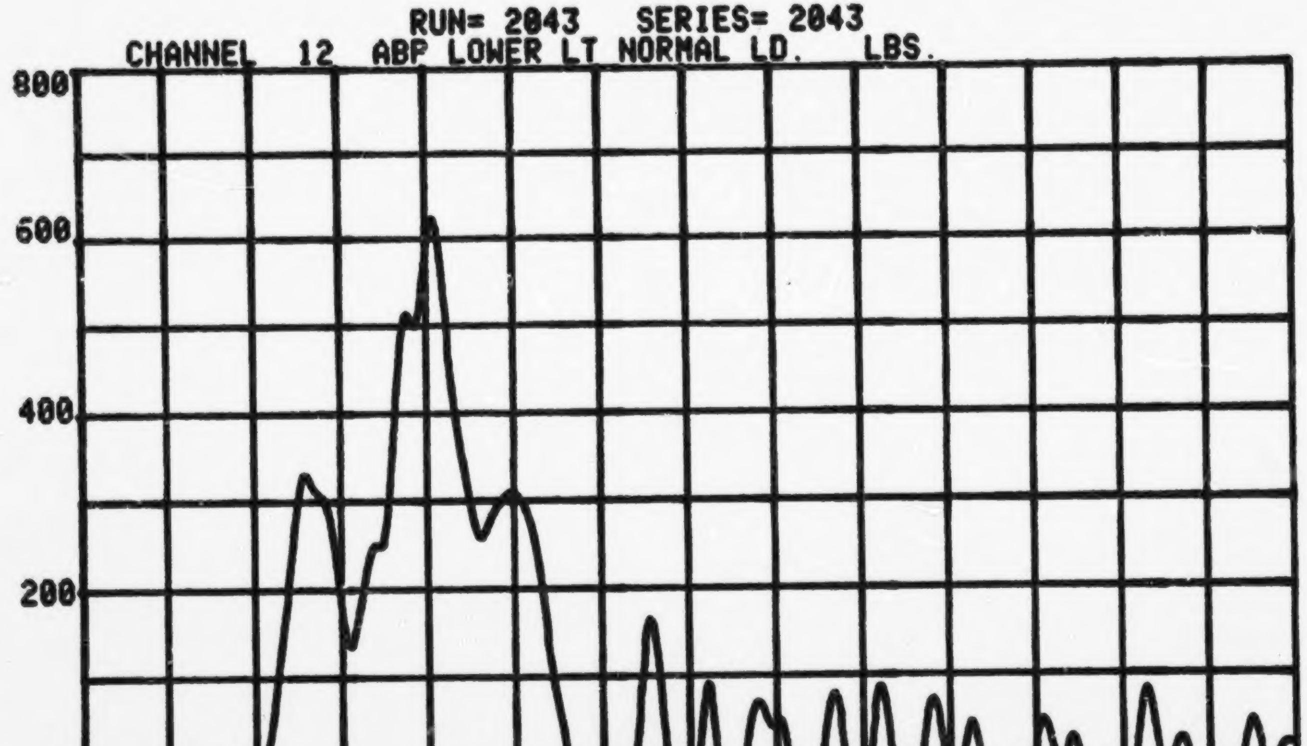


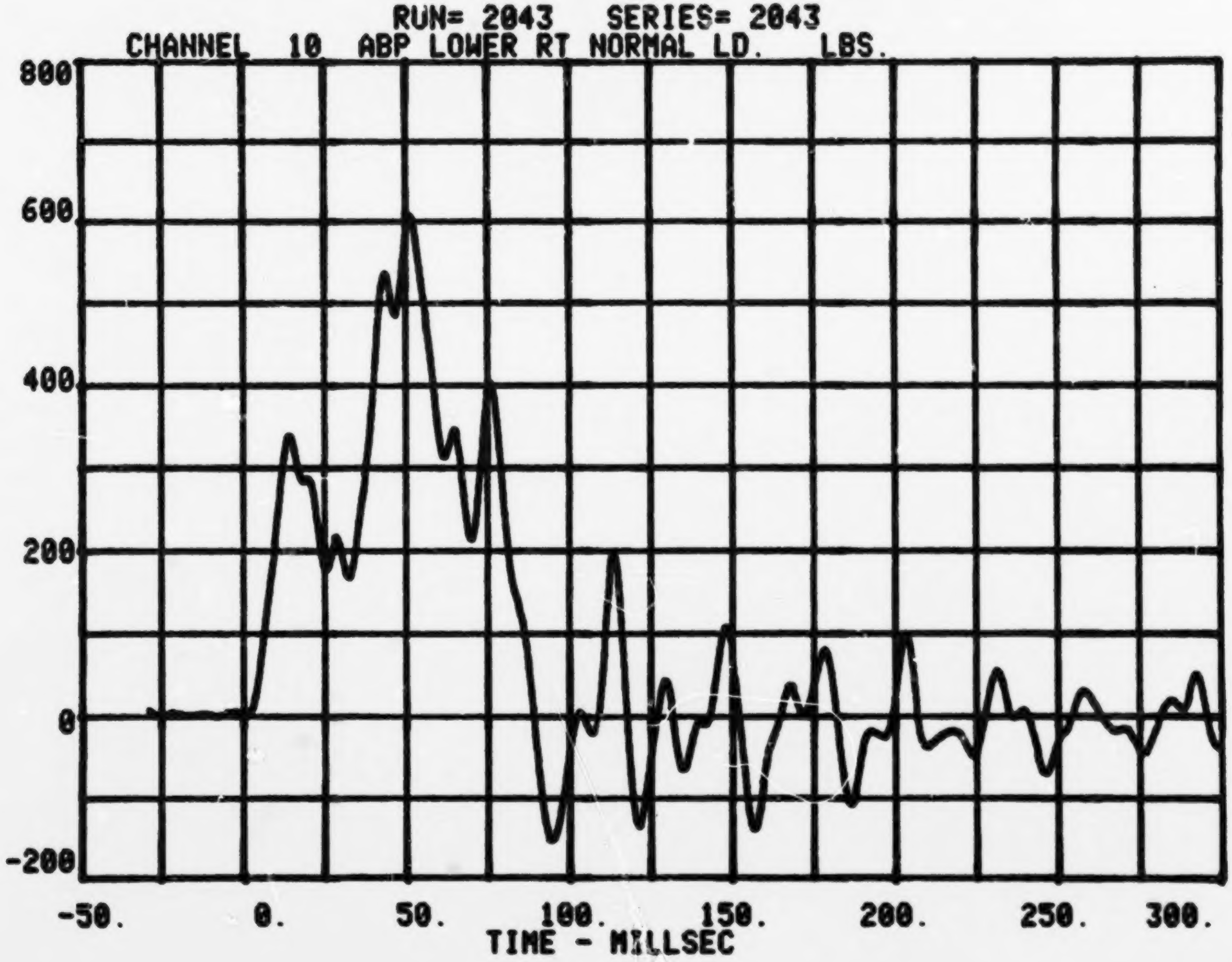
BEST DOCUMENT AVAILABLE

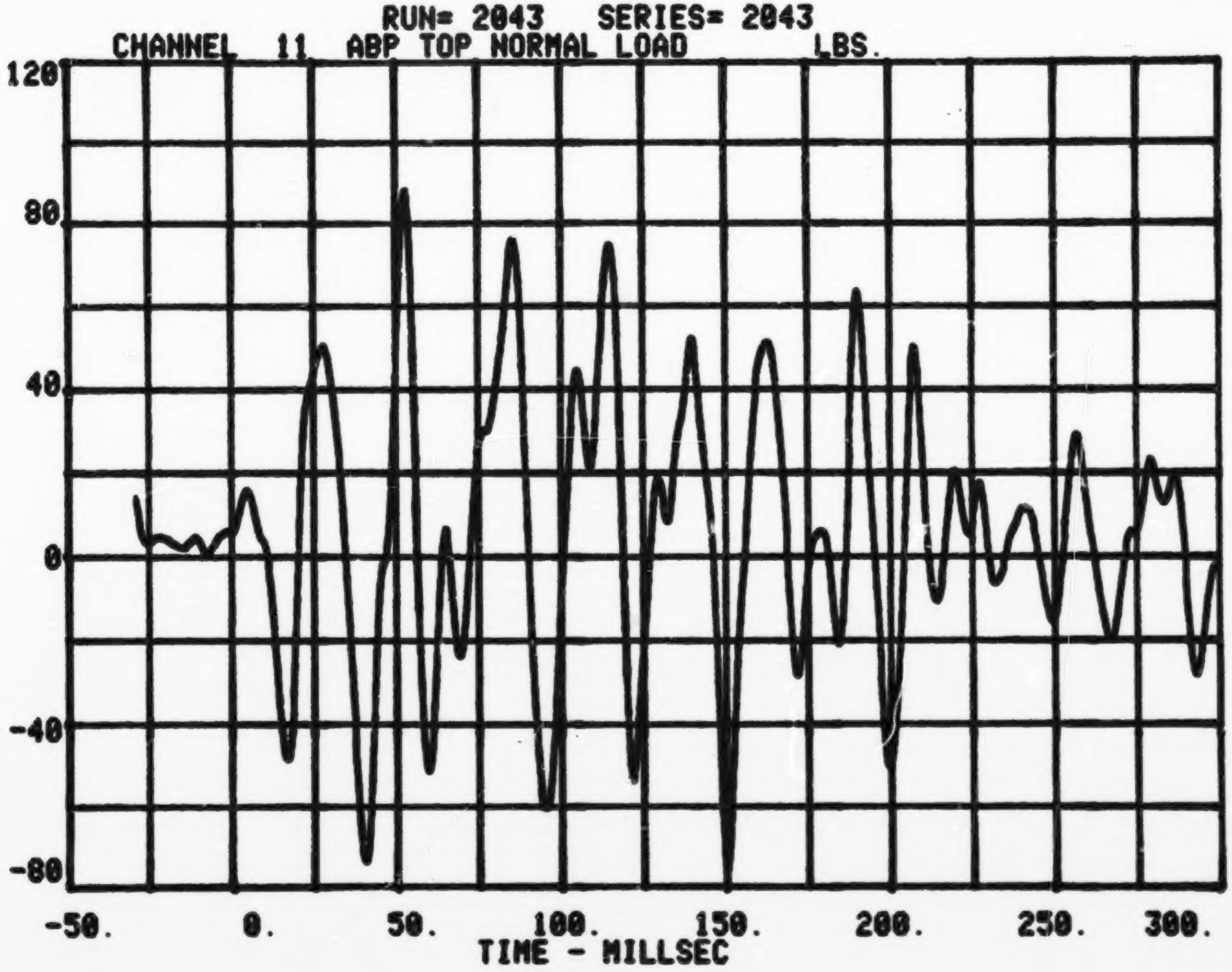

RUN= 2043 SERIES= 2043
CHANNEL 2 KNEEBAR NORMAL LOAD LBS.
8000
6000
4000
2000
0
-2000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

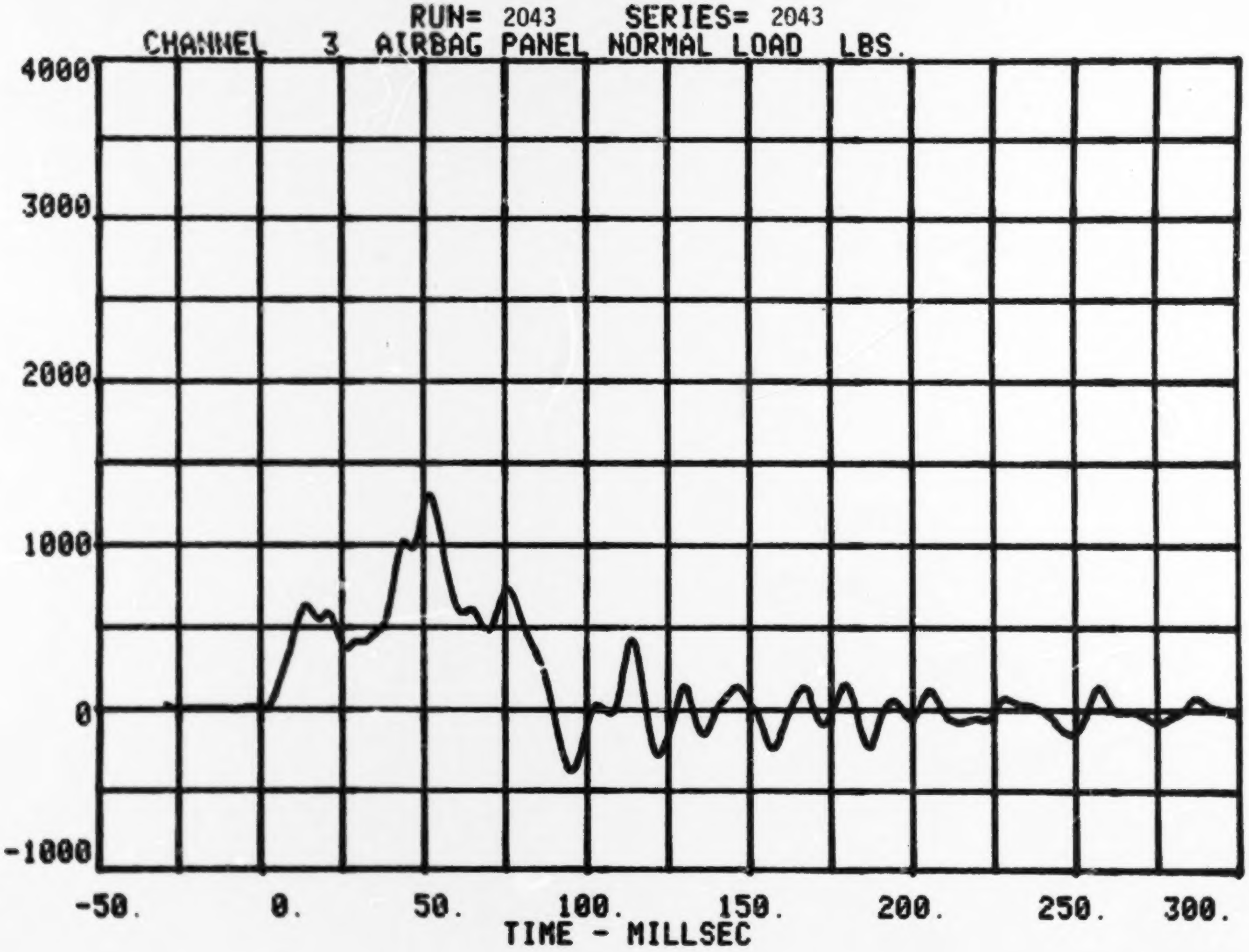


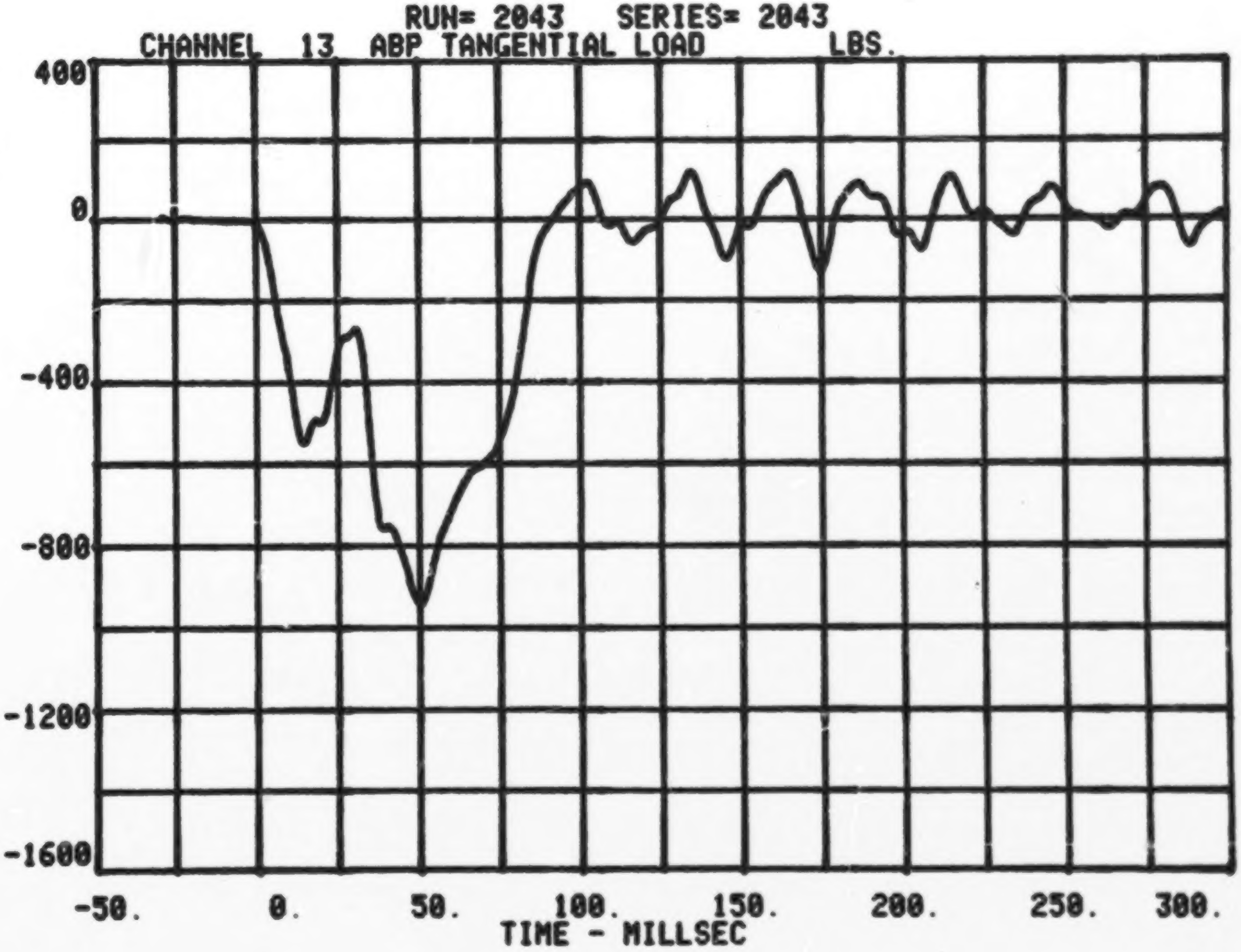
BEST DOCUMENT AVAILABLE


RUN= 2043 SERIES= 2043
CHANNEL 12 ABP LOWER LT NORMAL LD. LBS.
800
600
400
200
0
-200
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2043 SERIES= 2043
CHANNEL 10 ABP LOWER RT NORMAL LD. LBS.
800
600
400
200
0
-200
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

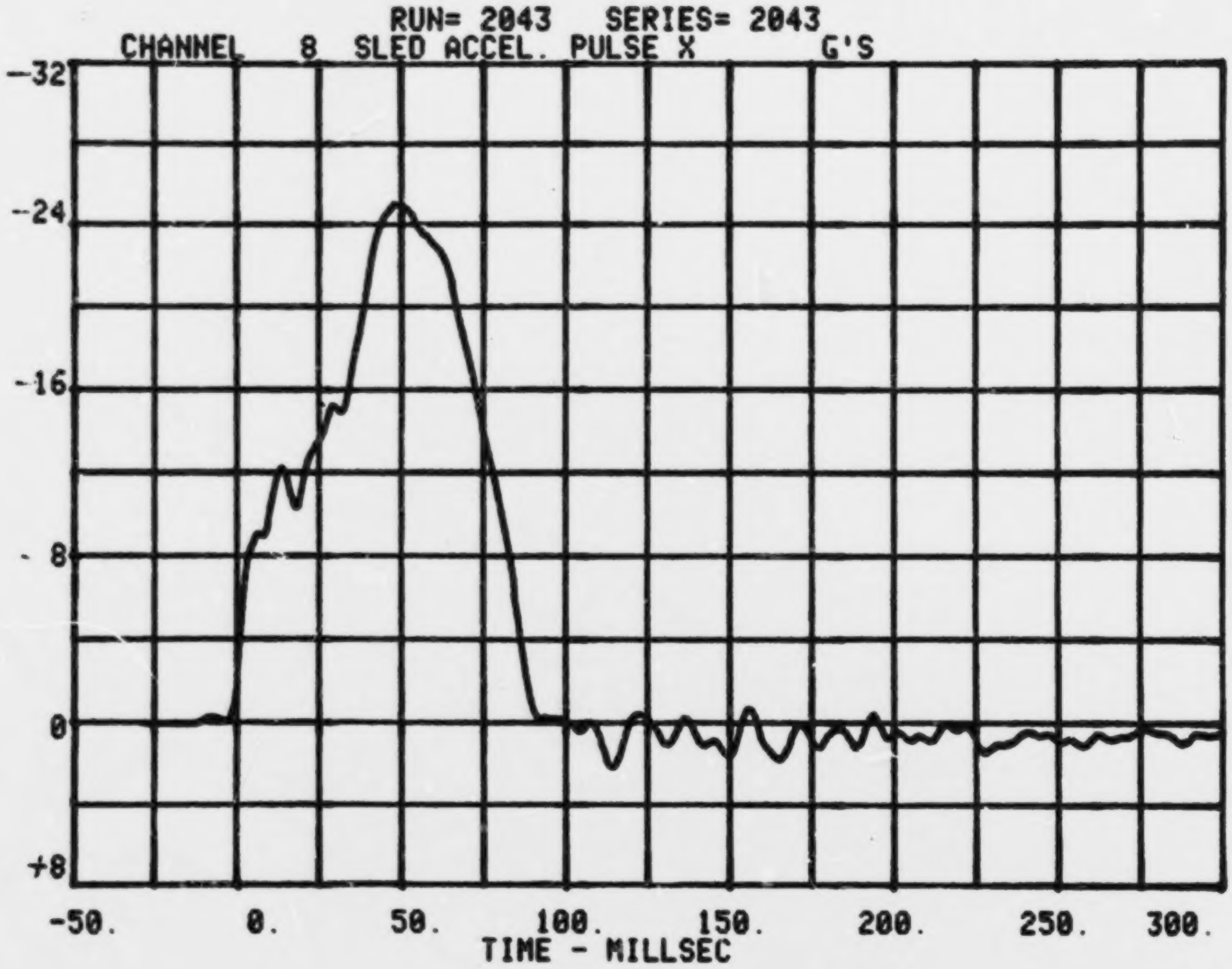

RUN= 2043 SERIES= 2043
CHANNEL 11 ABP TOP NORMAL LOAD LBS.
120
80
40
0
-40
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2043 SERIES= 2043
CHANNEL 3 AIRBAG PANEL NORMAL LOAD LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



RUN= 2043 SERIES= 2043

CHANNEL 13 ABP TANGENTIAL LOAD LBS.


RUN= 2043 SERIES= 2043
CHANNEL 8 SLED ACCEL. PULSE X G'S
-32
-24
-16
- 8
0
+8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE

APPENDIX B

SLED TEST 2047 DATA RECORDS (TARES FOR AIR BAG TEST NOS. 2045, 2046 AND BELT TEST NOS. 2049, 2050 AND 2051)

Measurement	Filter Channel Class
Loads	60
Sled Acceleration	60

Sequence of Data Records

Seat Normal Load - Front Left, Front Right, Rear, Sum

Seat Tangential Load

Toeboard Normal Load - Lower Left, Lower Right, Upper Center, Sum

Toeboard Tangential Load

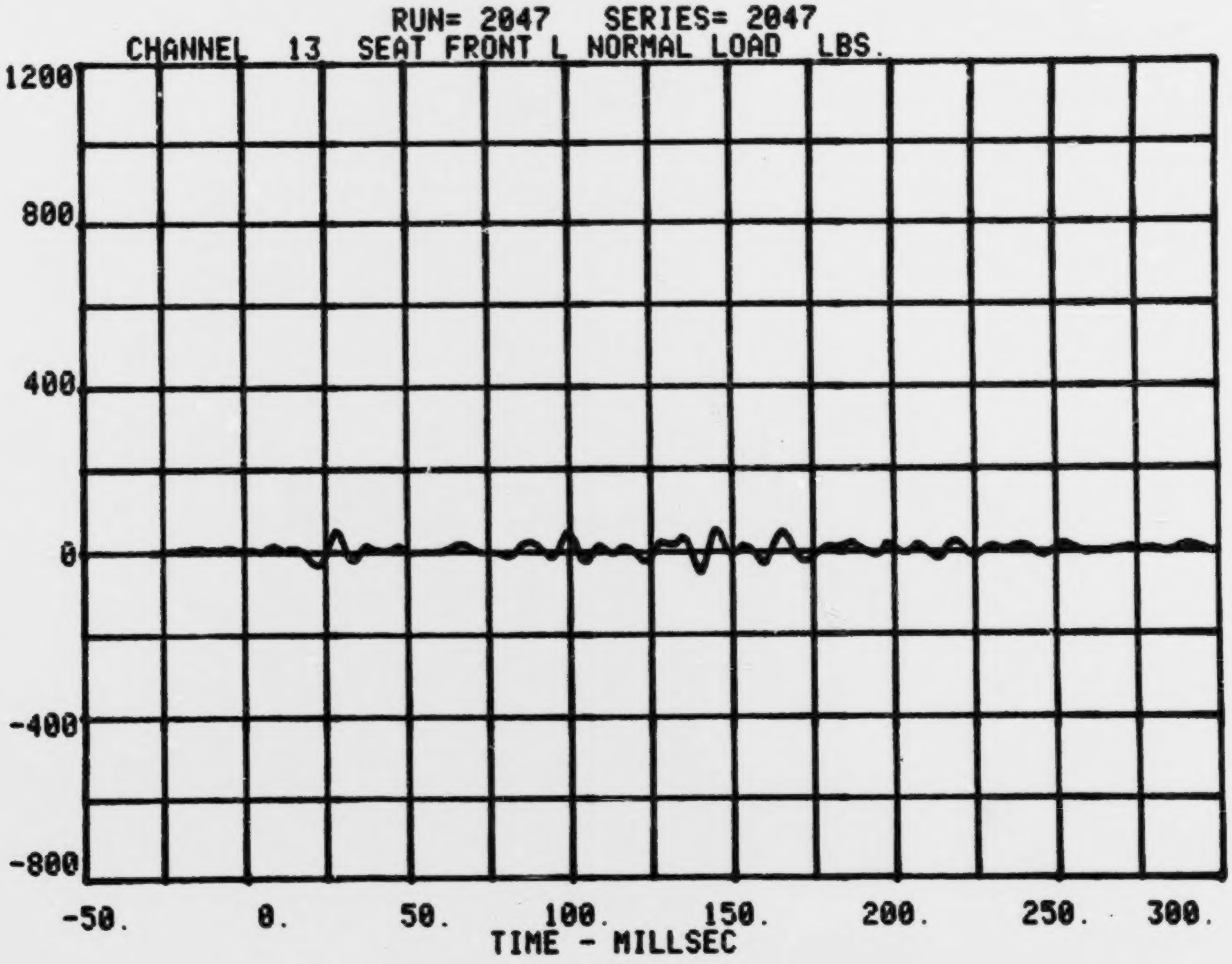
Knee Bolster Normal Load - Top Left, Top Right, Lower Center, Sum

Knee Bolster Tangential Load

Air Bag Panel Normal Load - Lower Left, Lower Right, Top, Sum

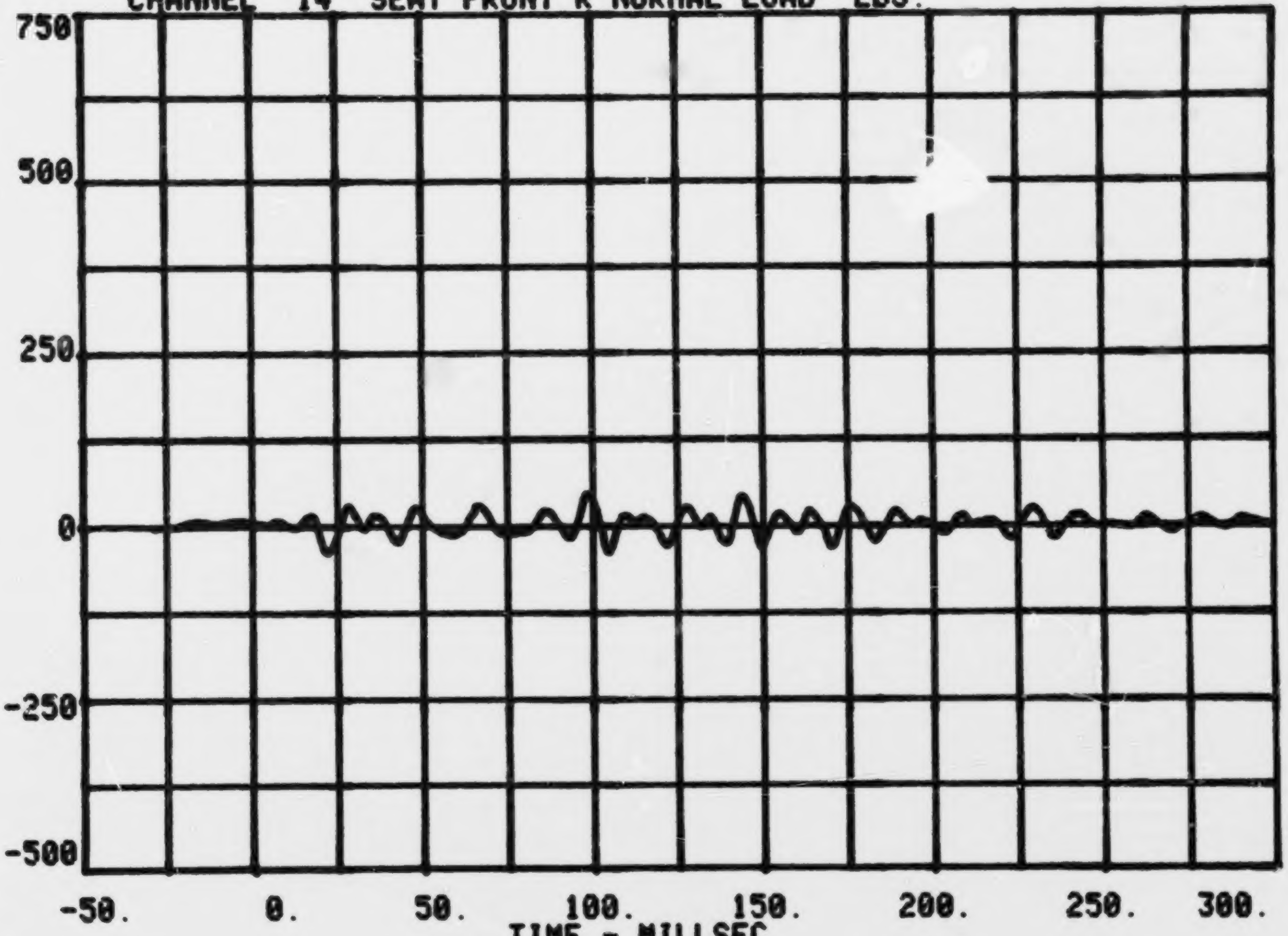
Air Bag Panel Tangential Load

Sled Acceleration

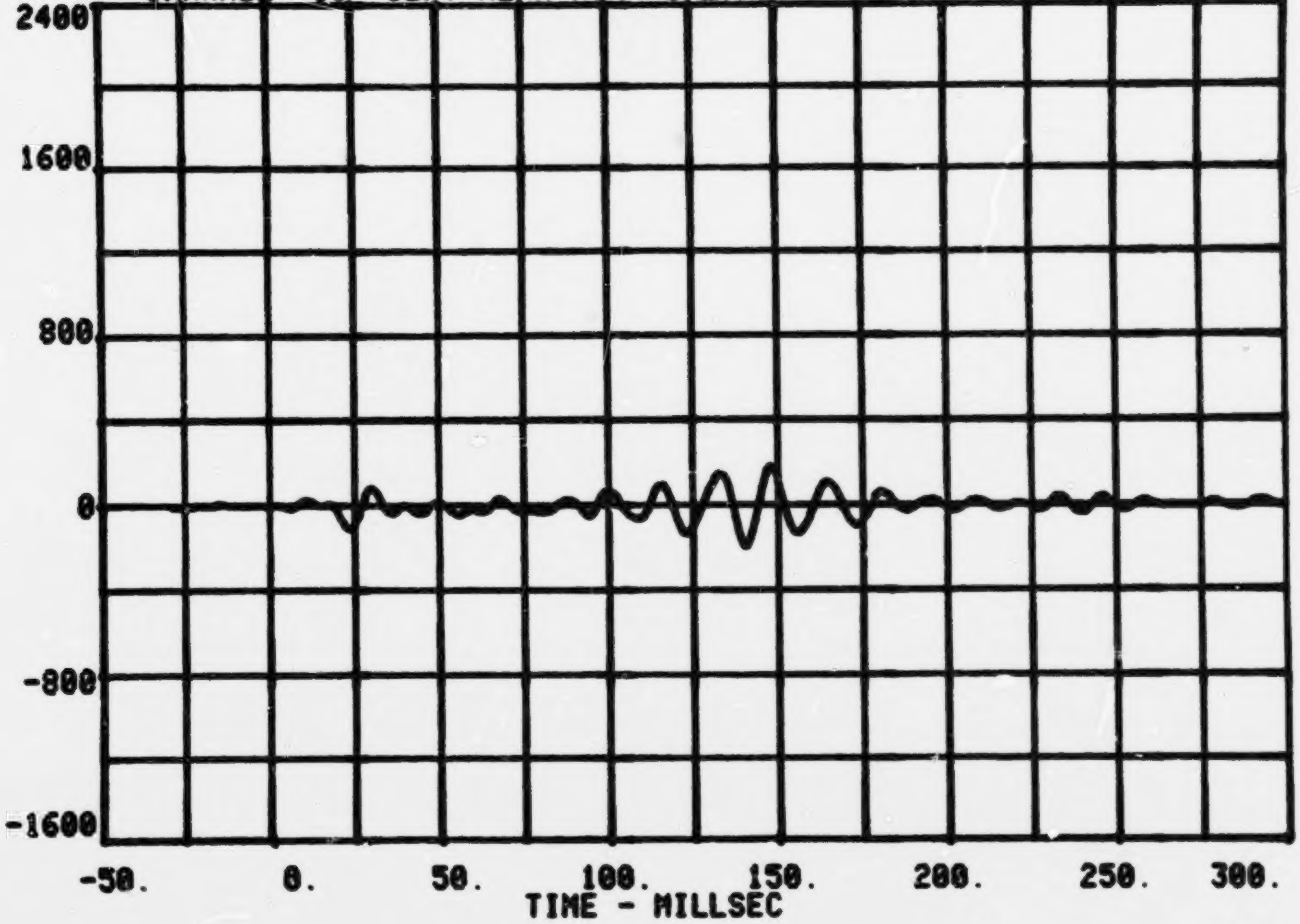


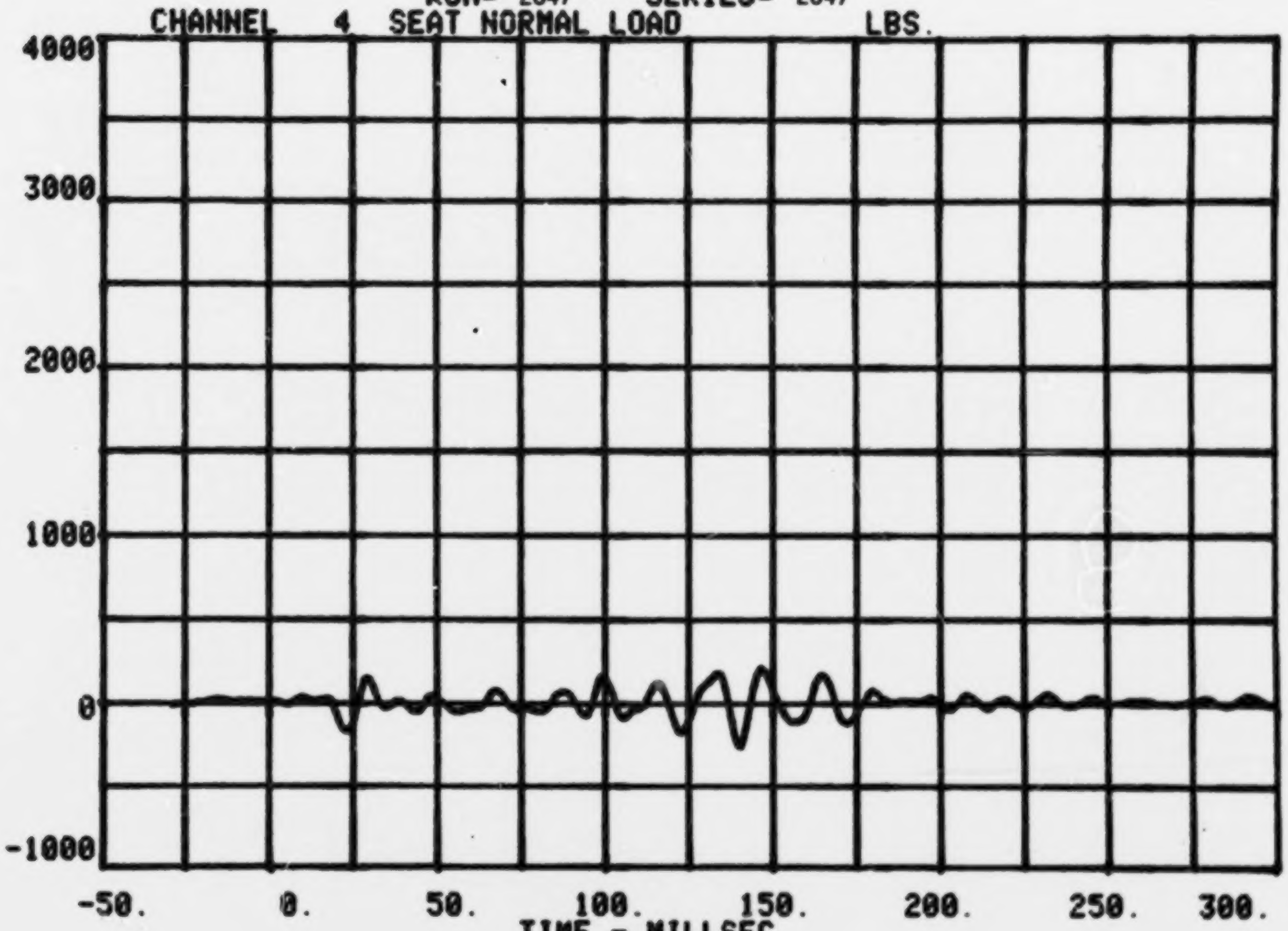
BEST DOCUMENT AVAILABLE

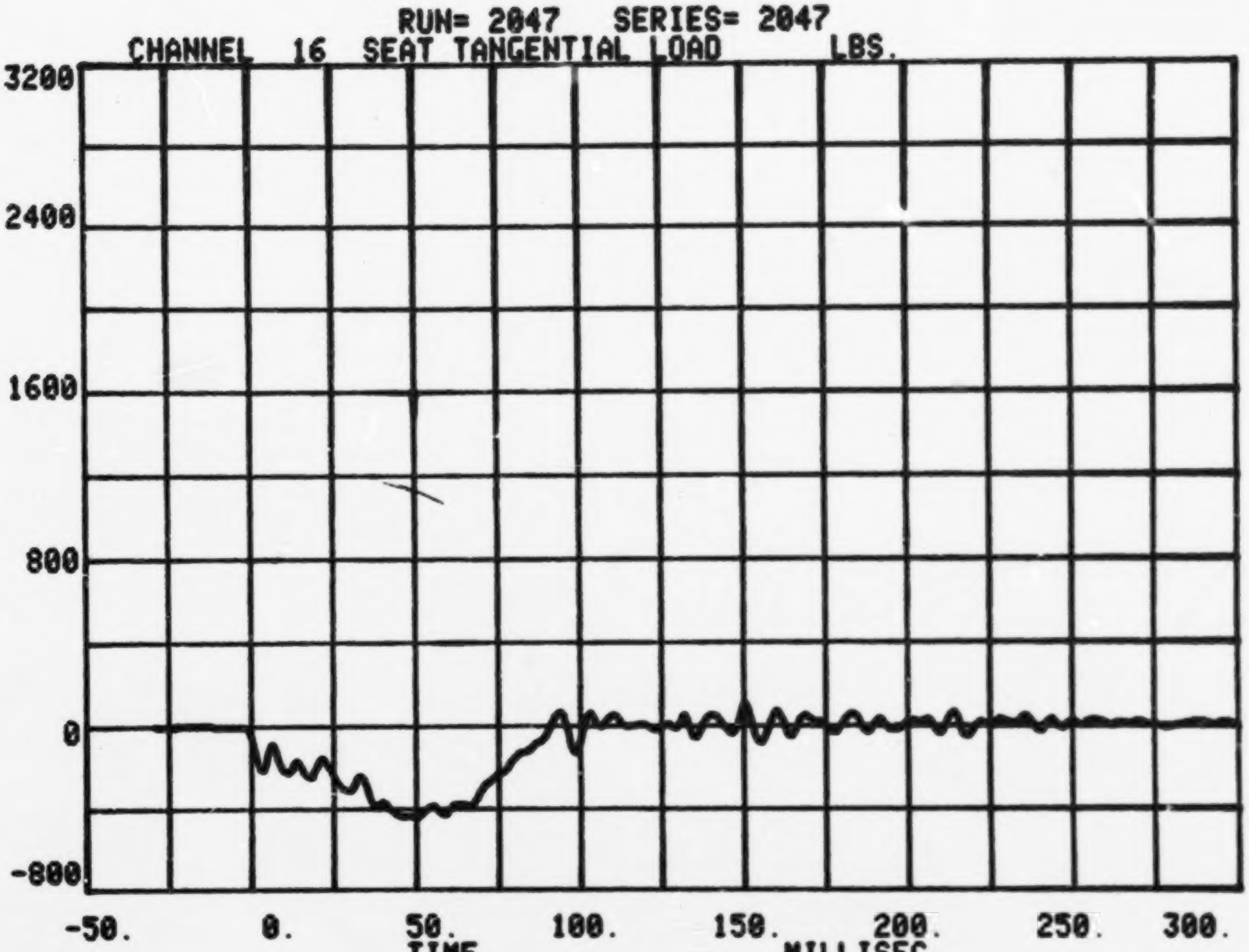
RUN= 2047 SERIES= 2047
CHANNEL 14 SEAT FRONT R NORMAL LOAD LBS.



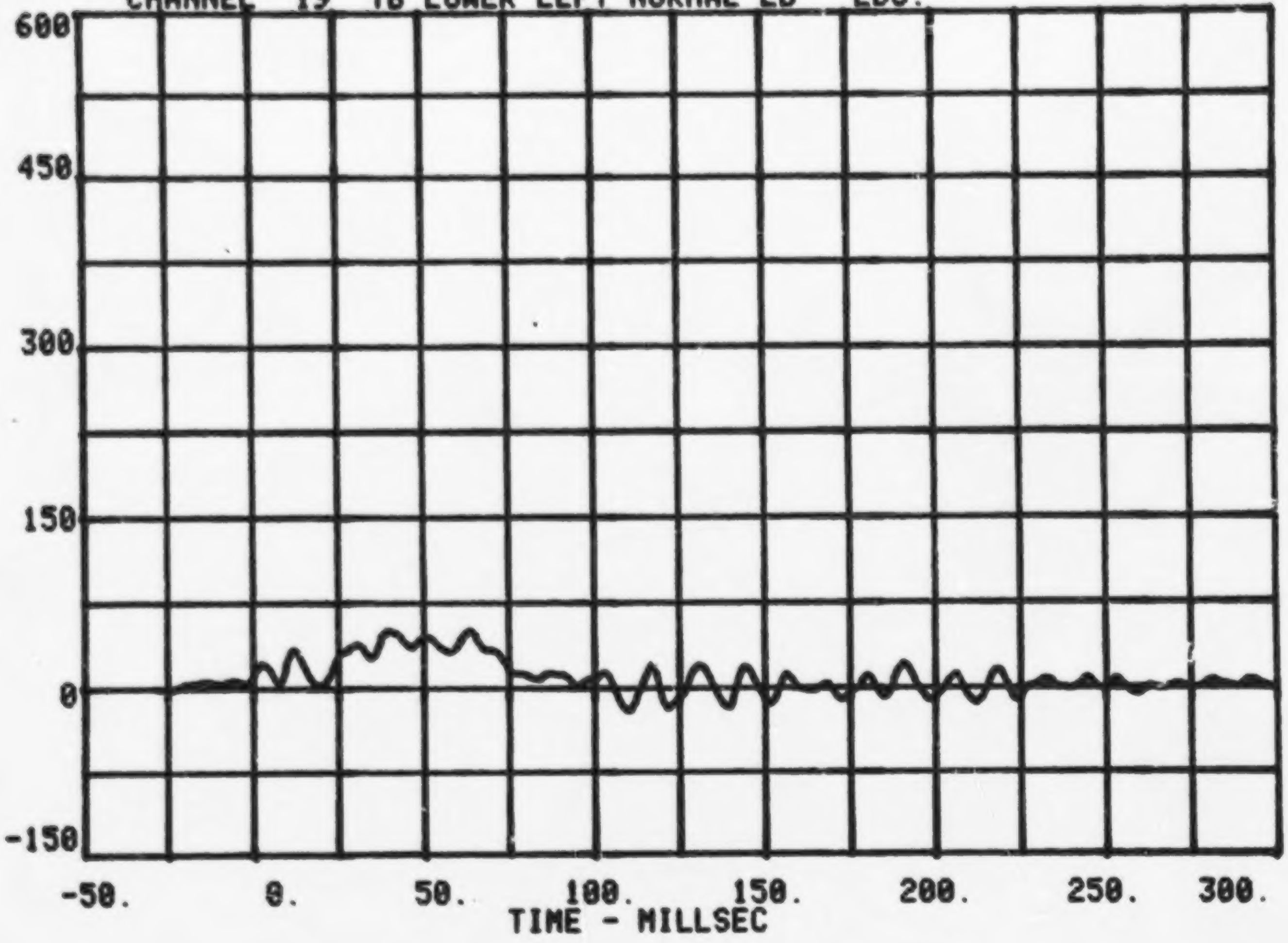
RUN= 2047 SERIES= 2047
CHANNEL 15 SEAT REAR NORMAL LOAD LBS.



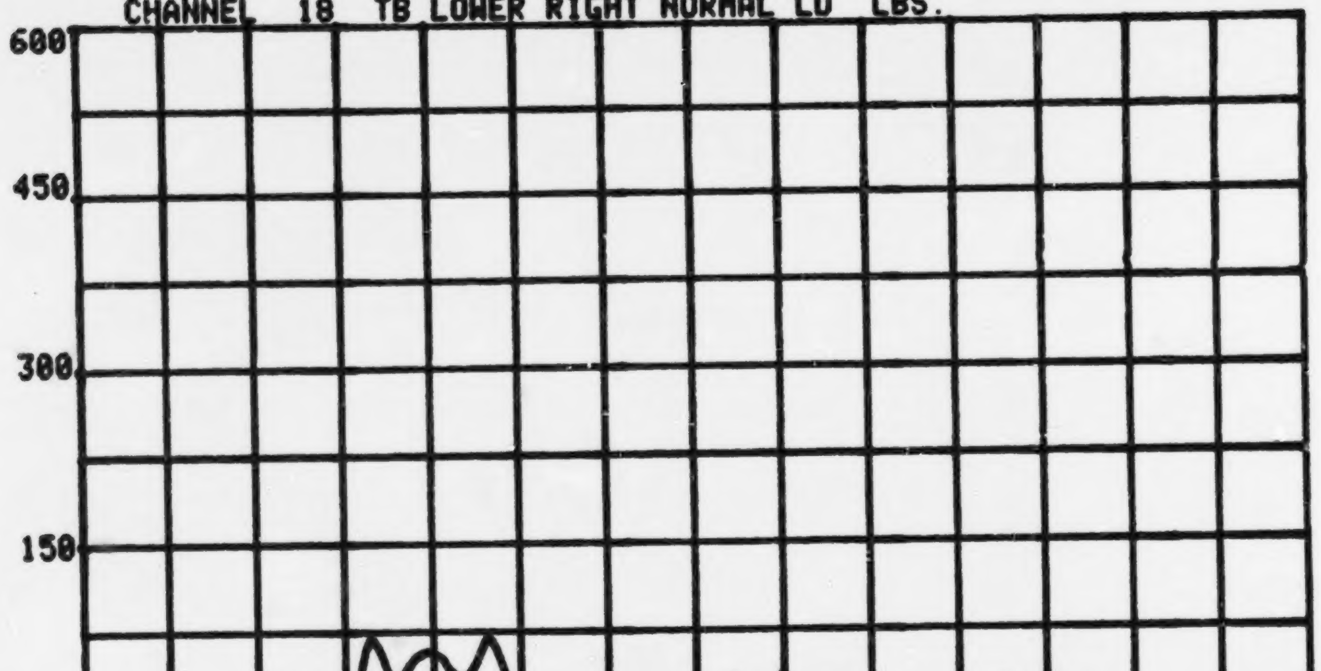

RUN= 2047 SERIES= 2047
CHANNEL 4 SEAT NORMAL LOAD LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

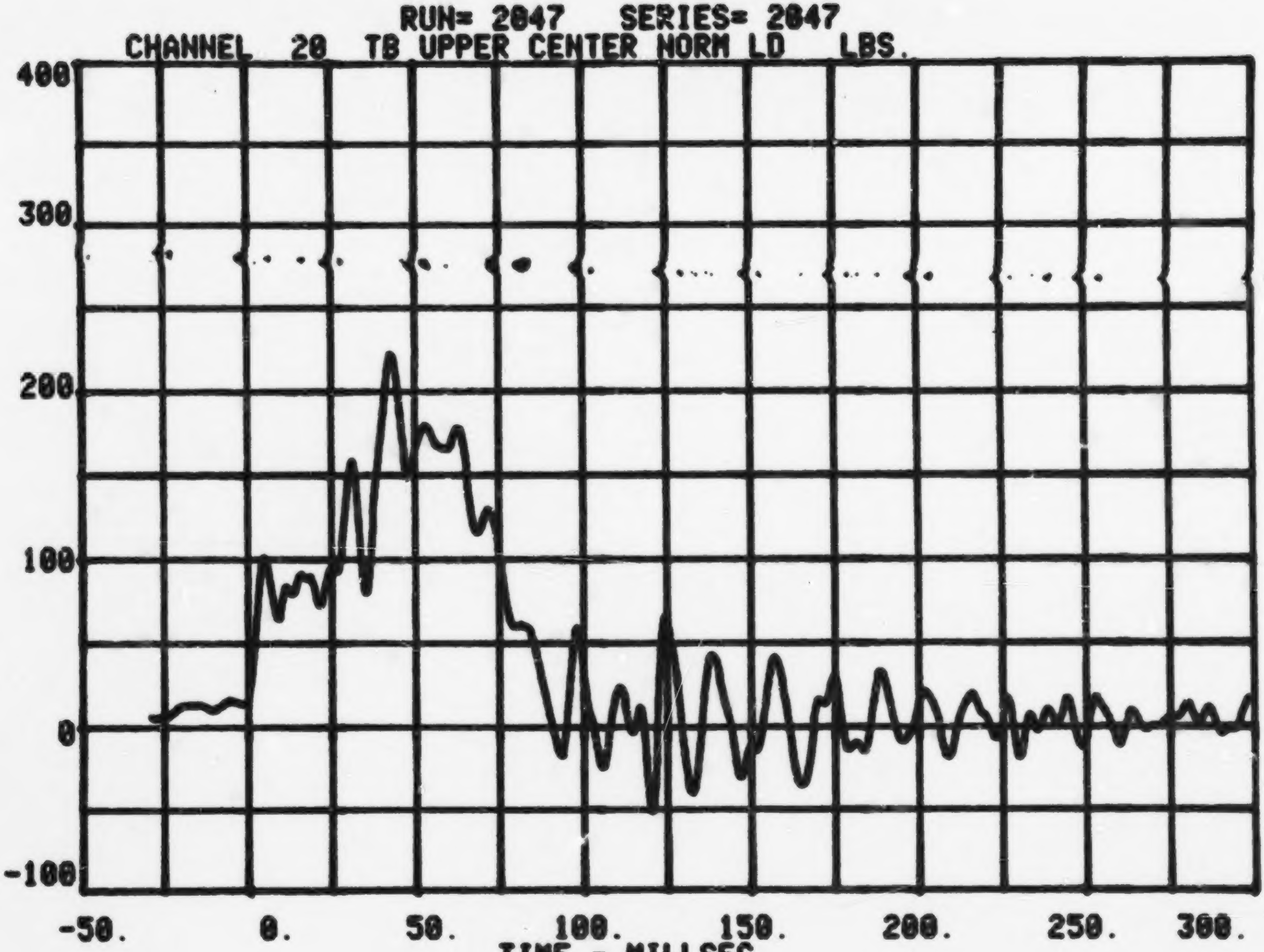

RUN= 2047 SERIES= 2047
CHANNEL 16 SEAT TANGENTIAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

RUN= 2047   SERIES= 2047
CHANNEL 19 TB LOWER LEFT NORMAL LD   LBS.



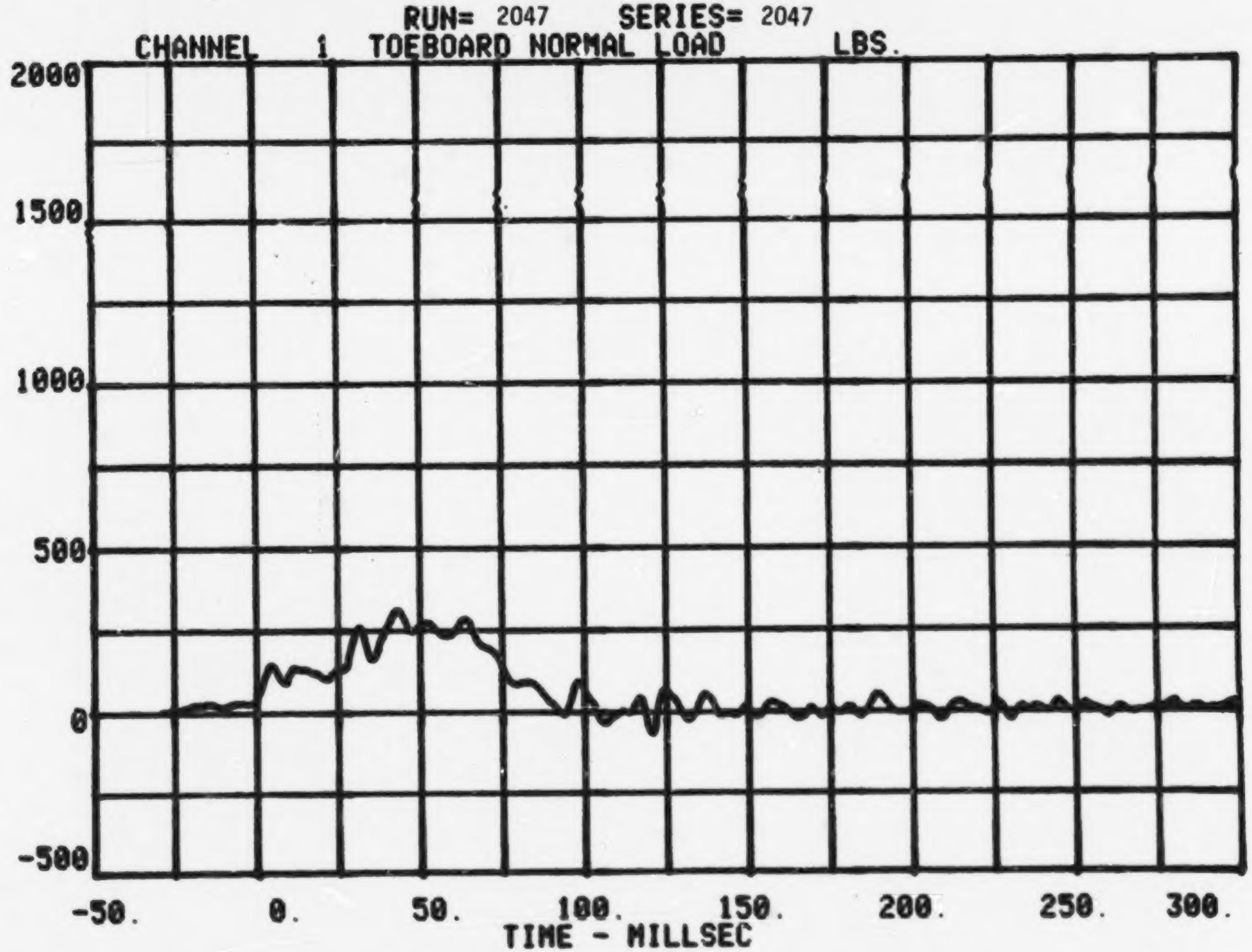
RUN= 2047 SERIES= 2047
CHANNEL 18 TB LOWER RIGHT NORMAL LD LBS.





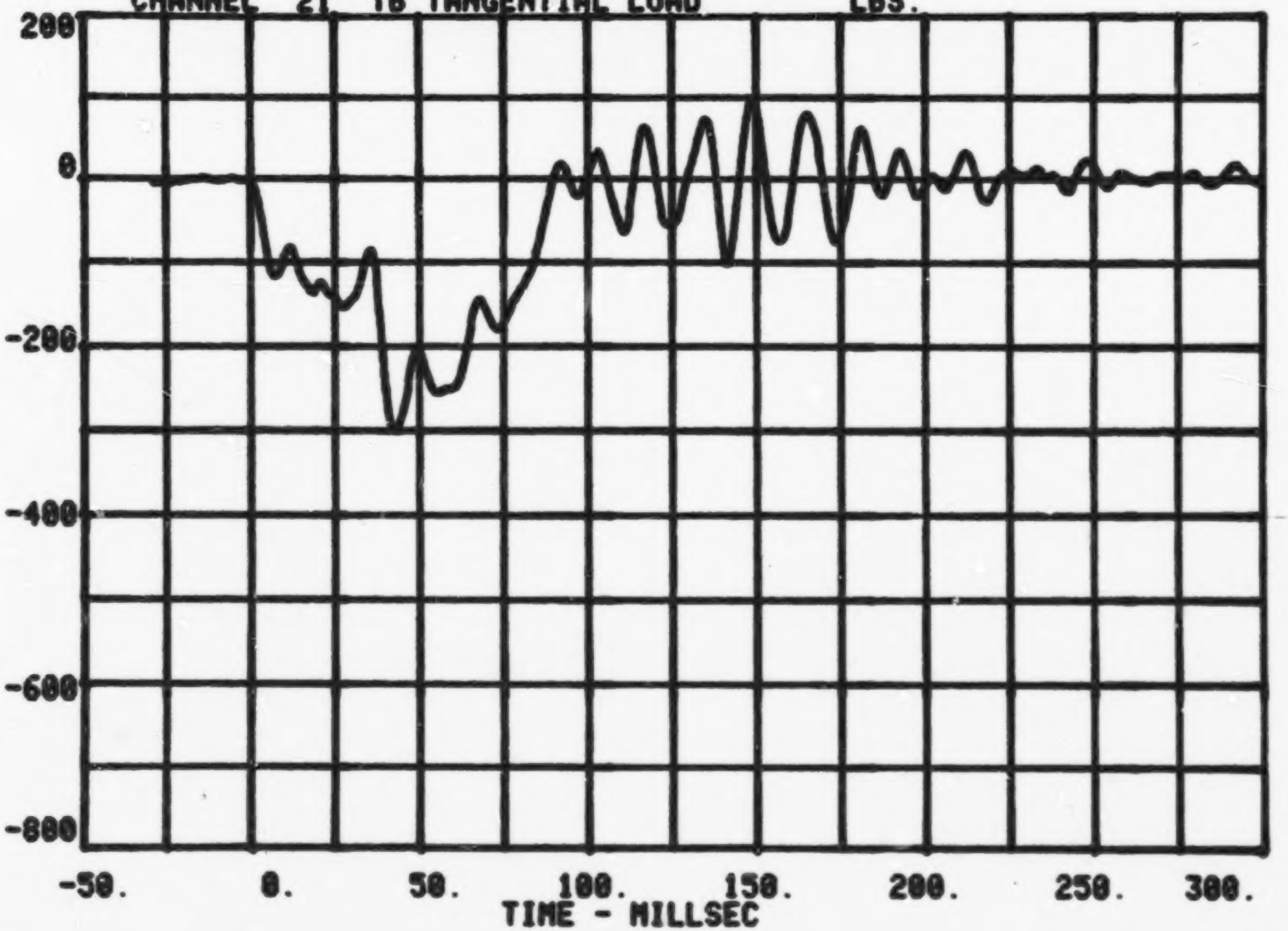
RUN= 2047 SERIES= 2047

CHANNEL 20 TB UPPER CENTER NORM LD LBS.

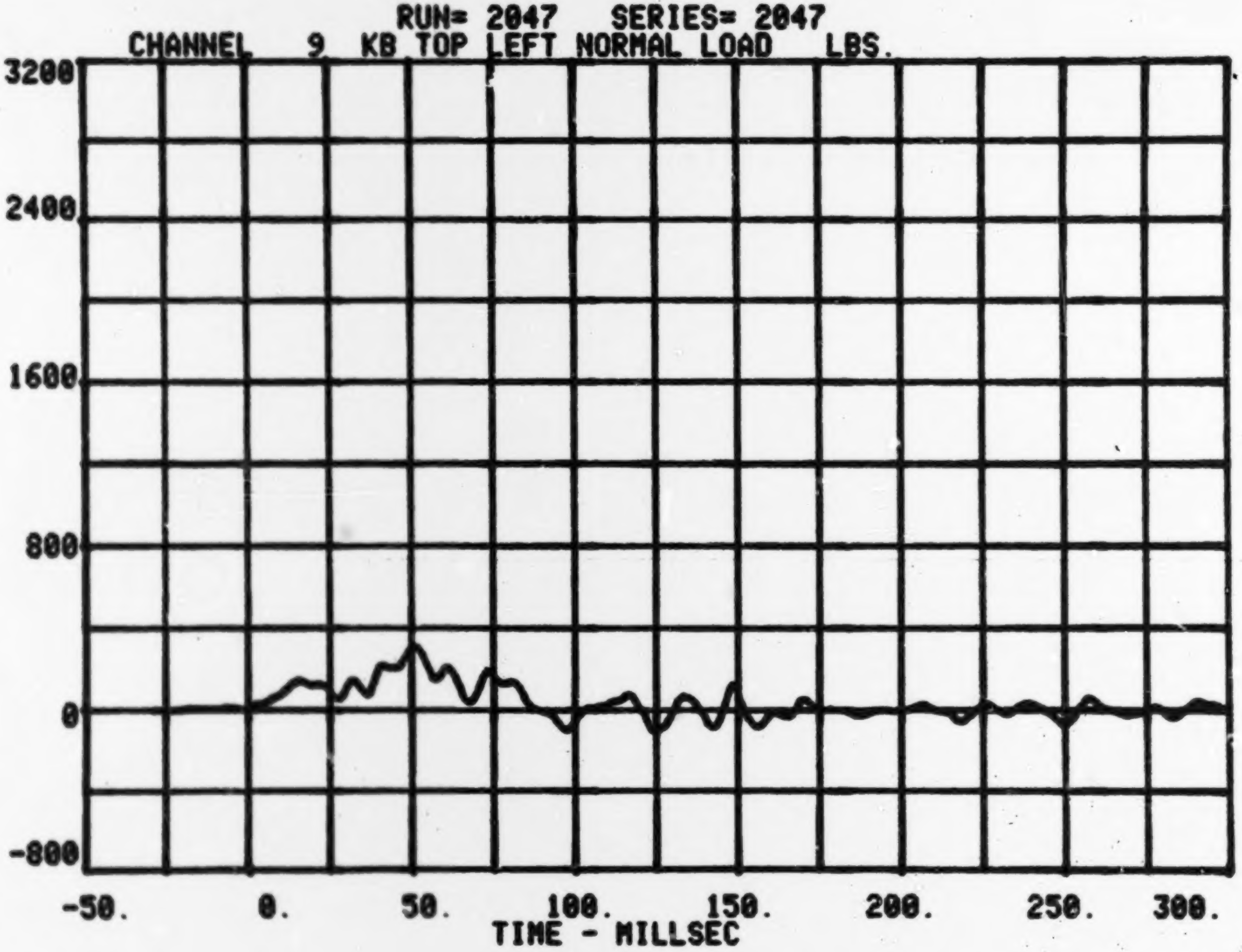


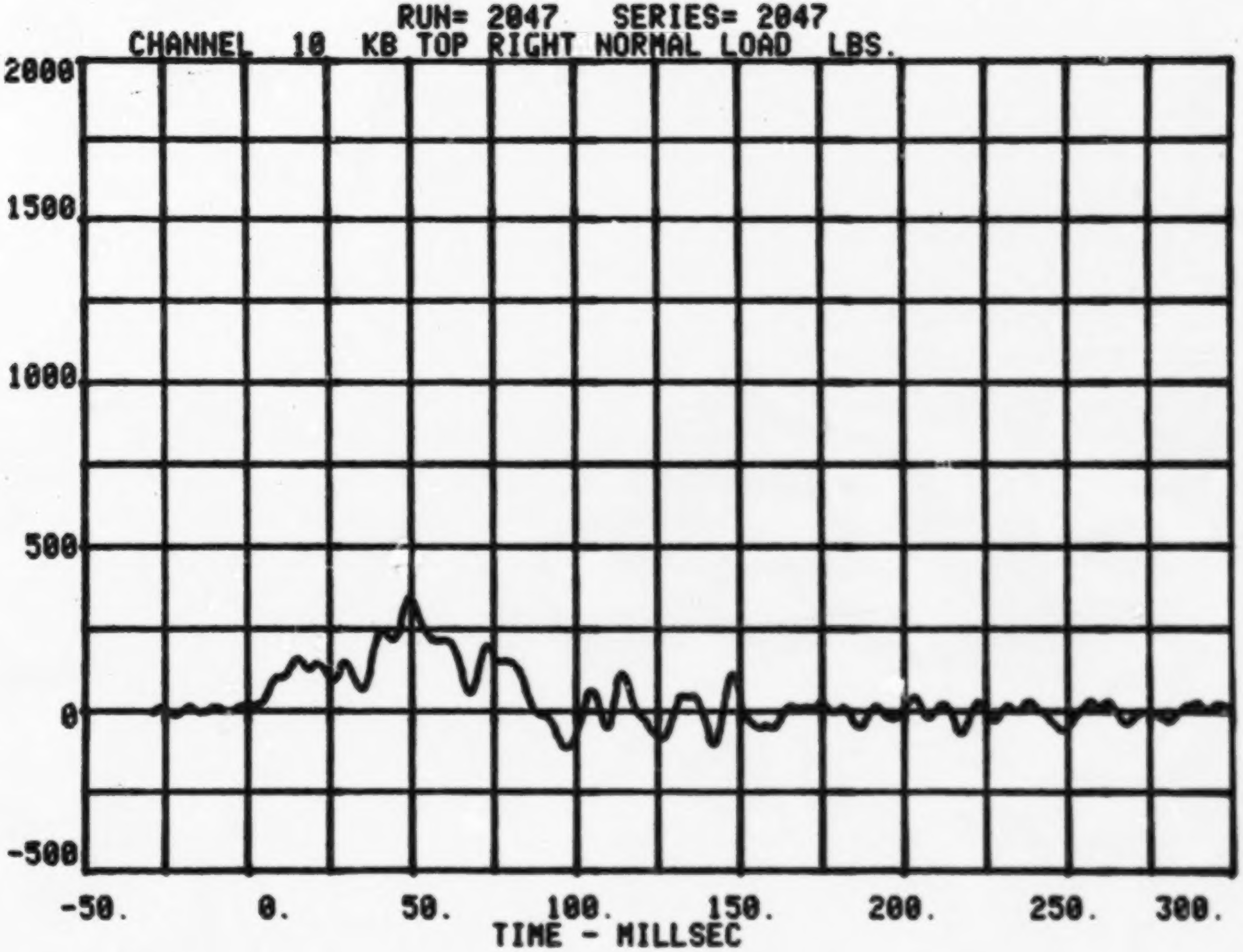
BEST DOCUMENT AVAILABLE

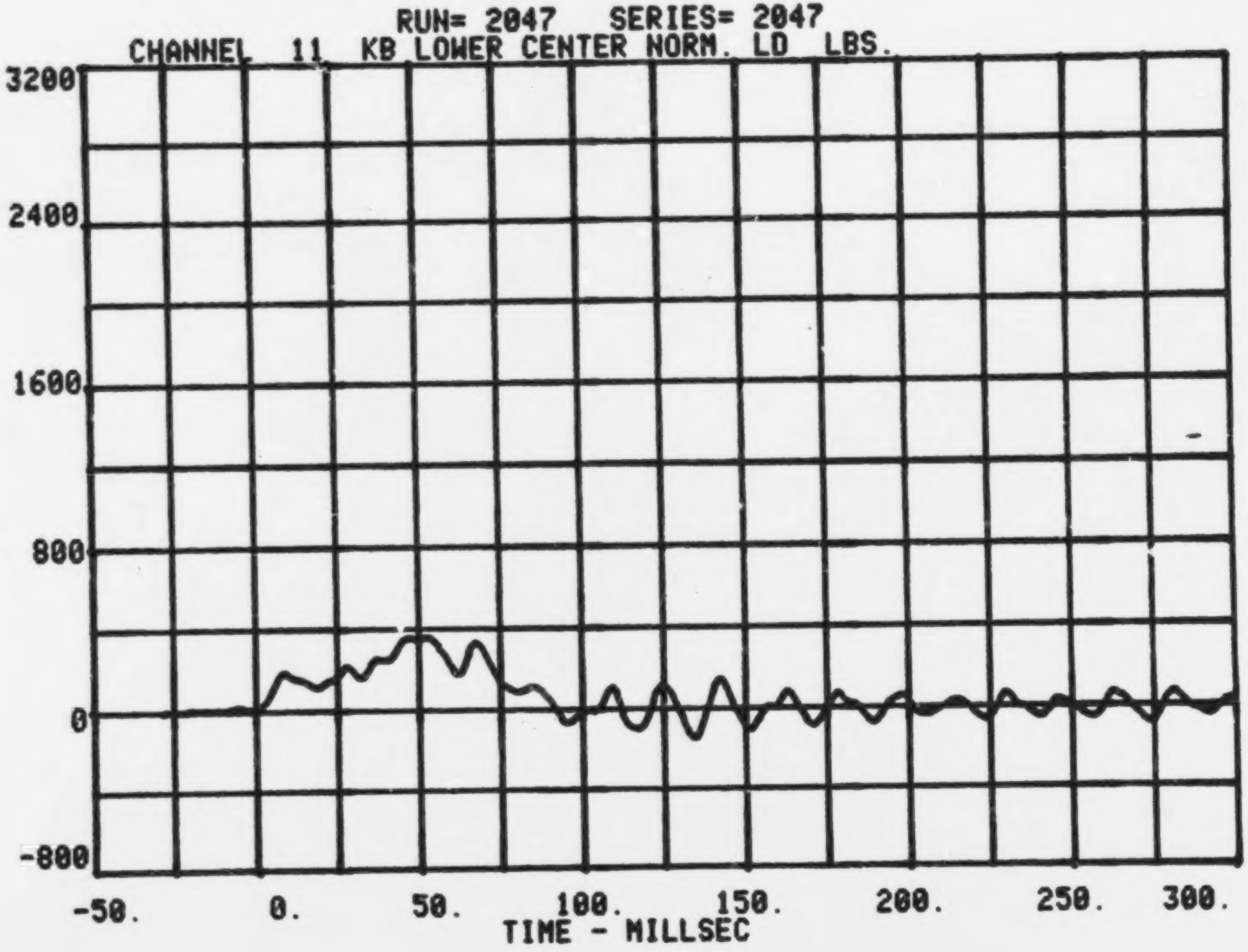
RUN= 2047 SERIES= 2047
CHANNEL 21 TB TANGENTIAL LOAD LBS.



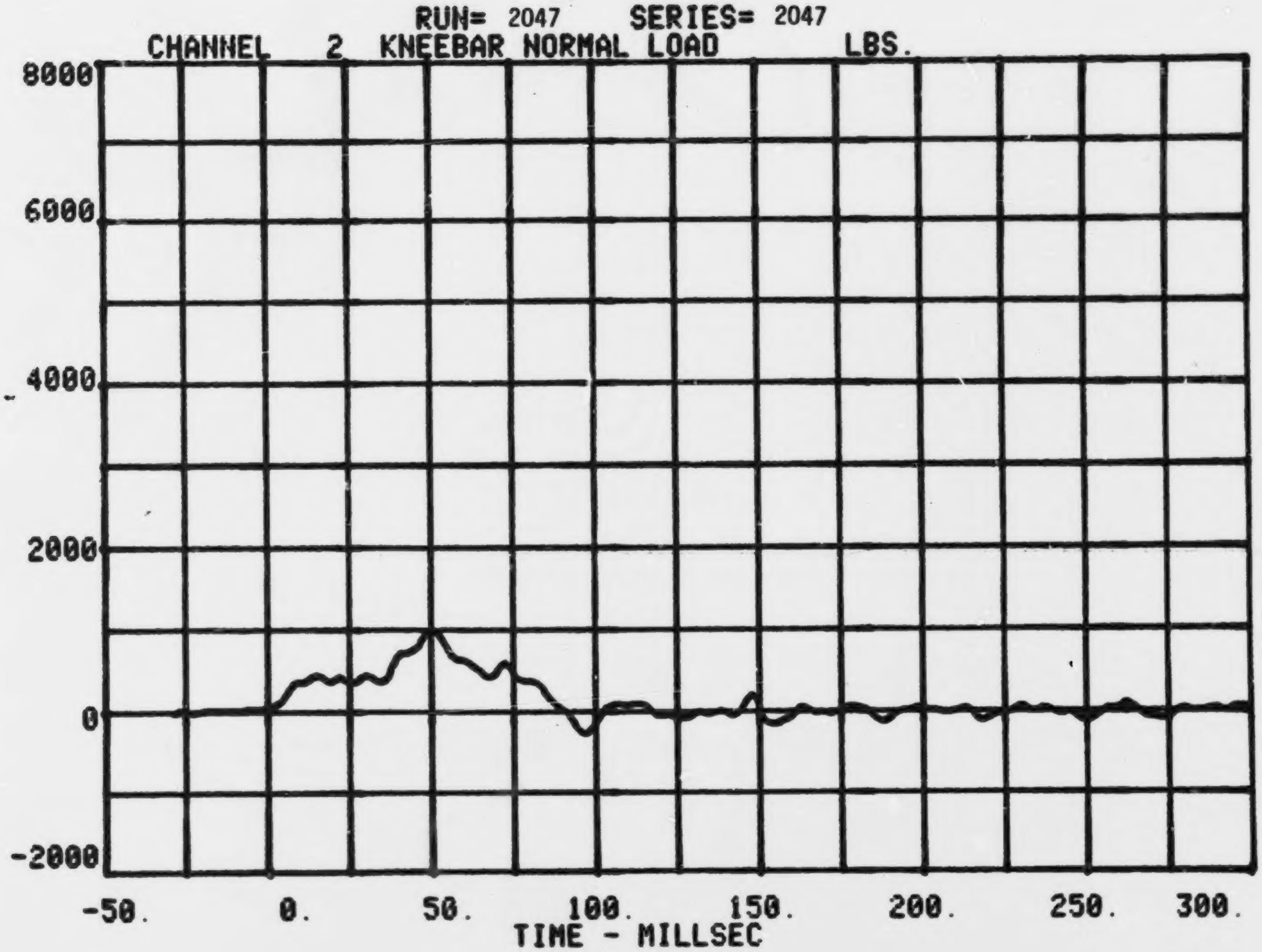
BEST DOCUMENT AVAILABLE

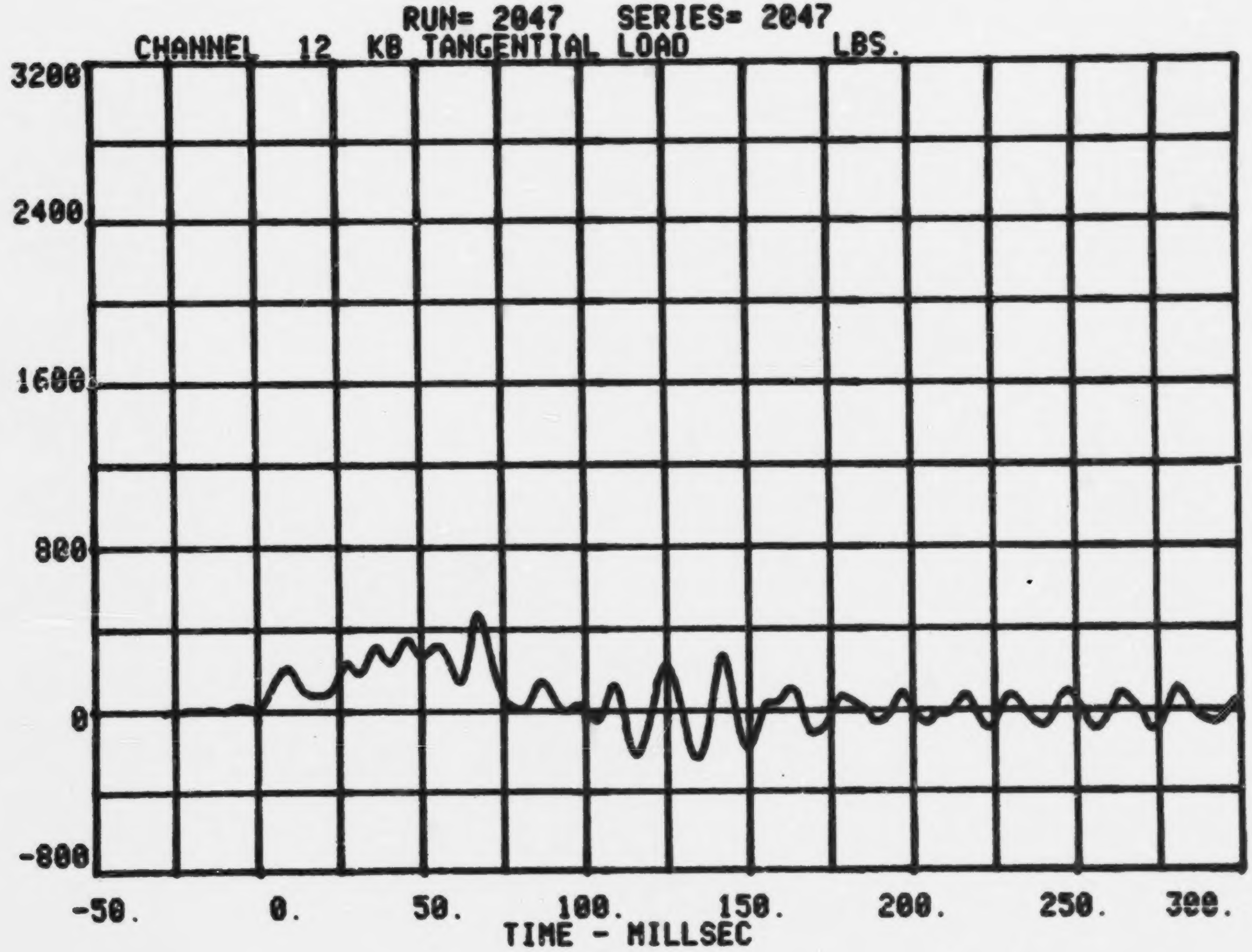

RUN= 2047 SERIES= 2047
CHANNEL 9 KB TOP LEFT NORMAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

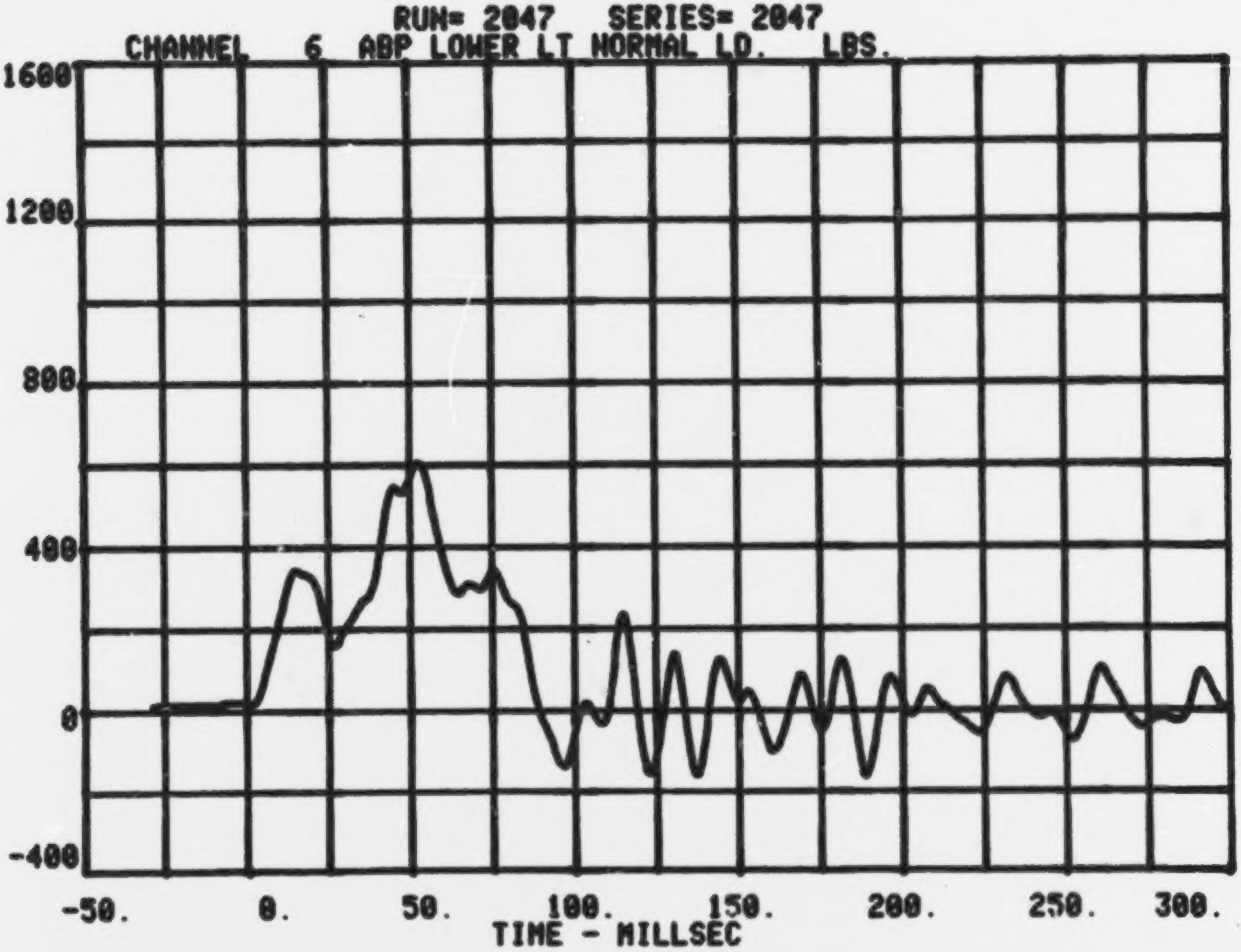

RUN= 2047 SERIES= 2047
CHANNEL 10 KB TOP RIGHT NORMAL LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

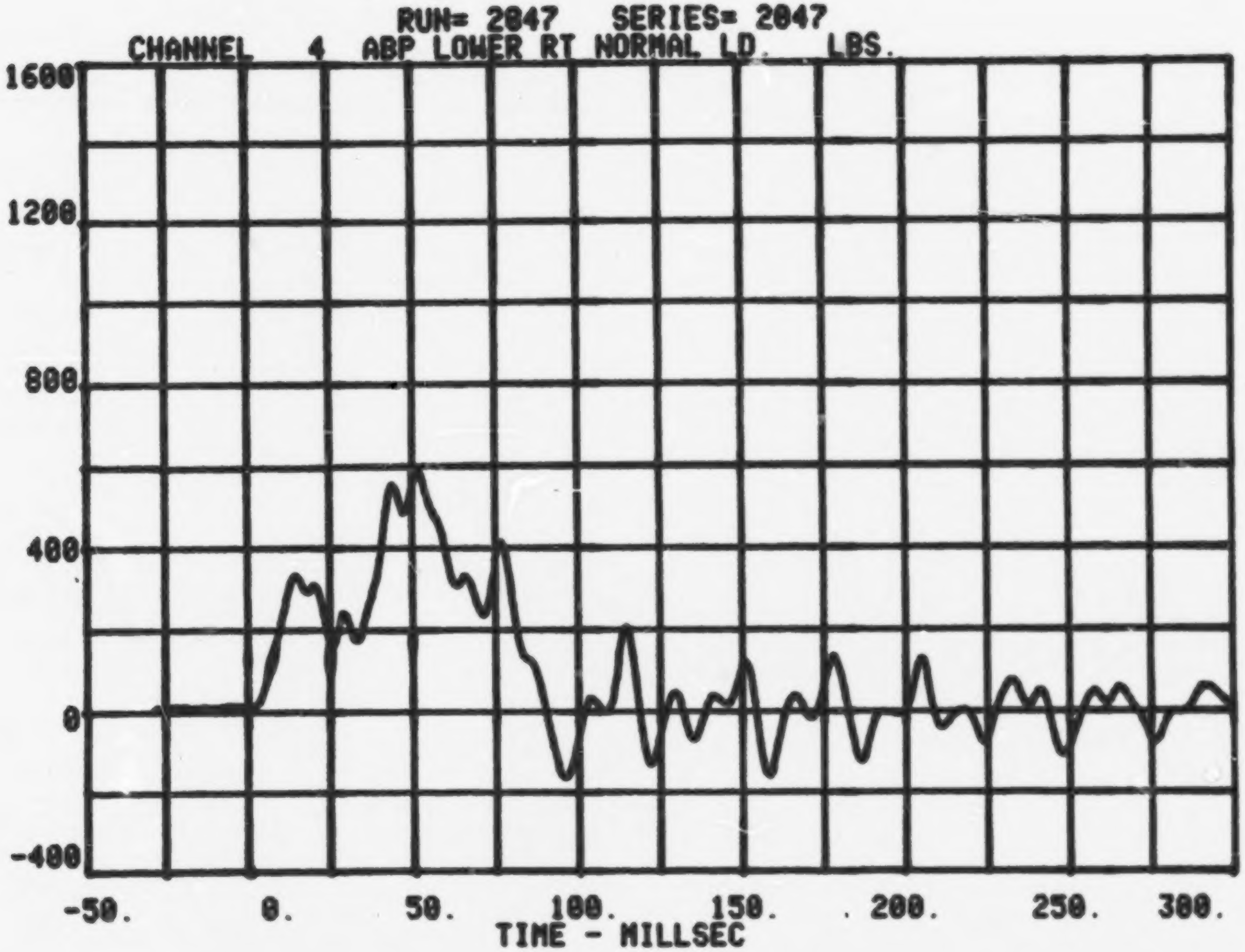

RUN= 2047 SERIES= 2047
CHANNEL 11 KB LOWER CENTER NORM. LD LBS.

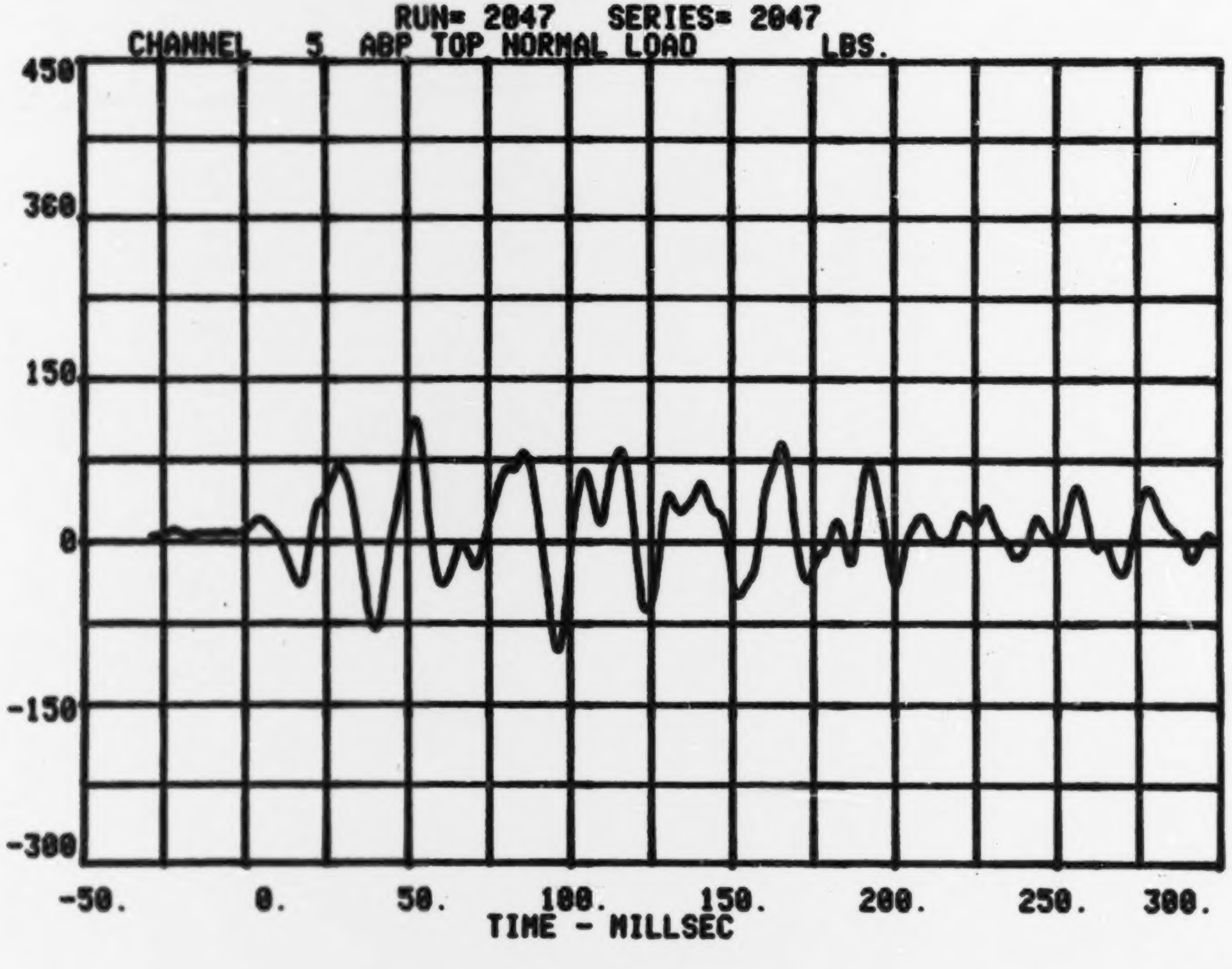
BEST DOCUMENT AVAILABLE

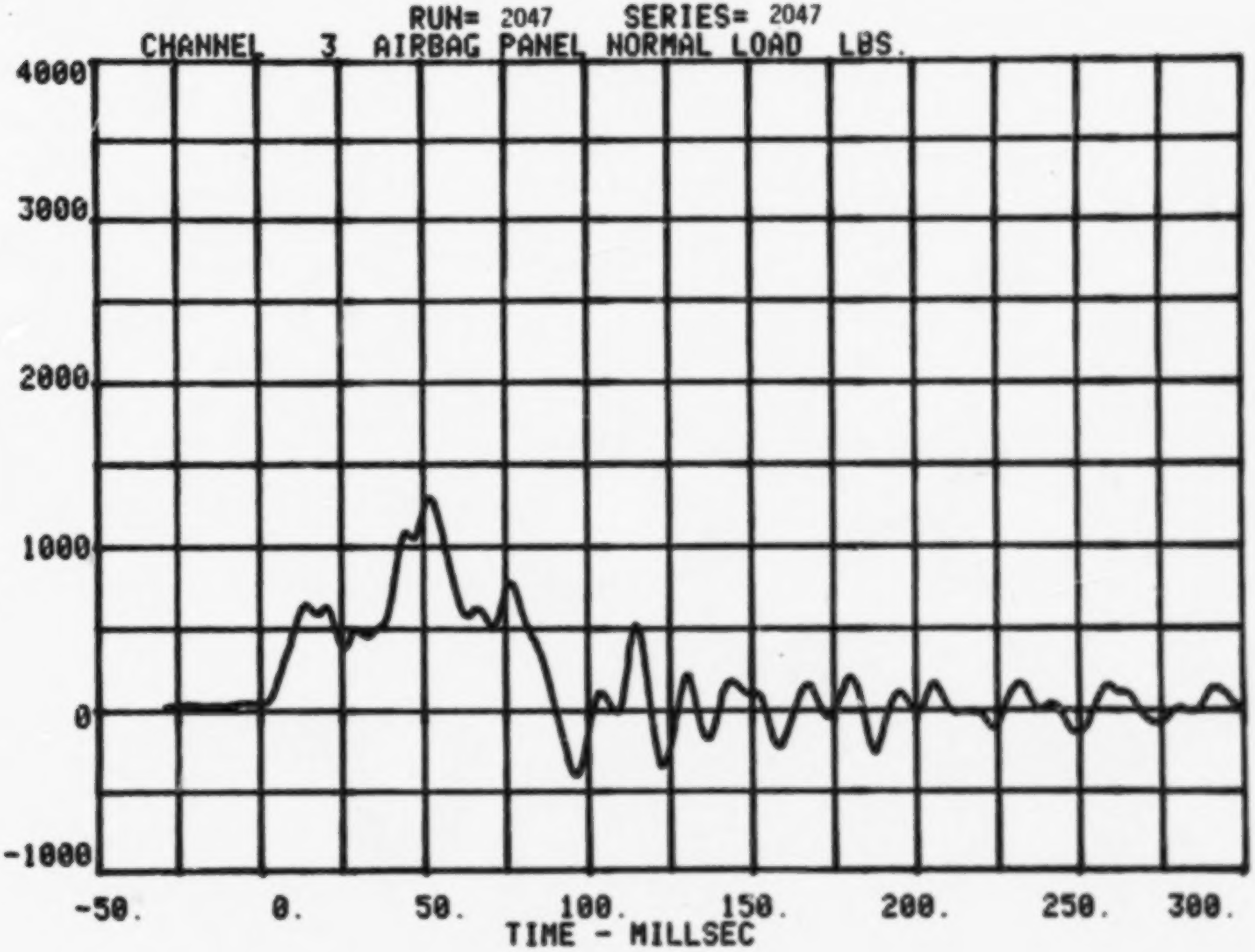

RUN= 2047 SERIES= 2047
CHANNEL 2 KNEEBAR NORMAL LOAD LBS.
8000
6000
4000
2000
0
-2000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2047 SERIES= 2047
CHANNEL 12 KB TANGENTIAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

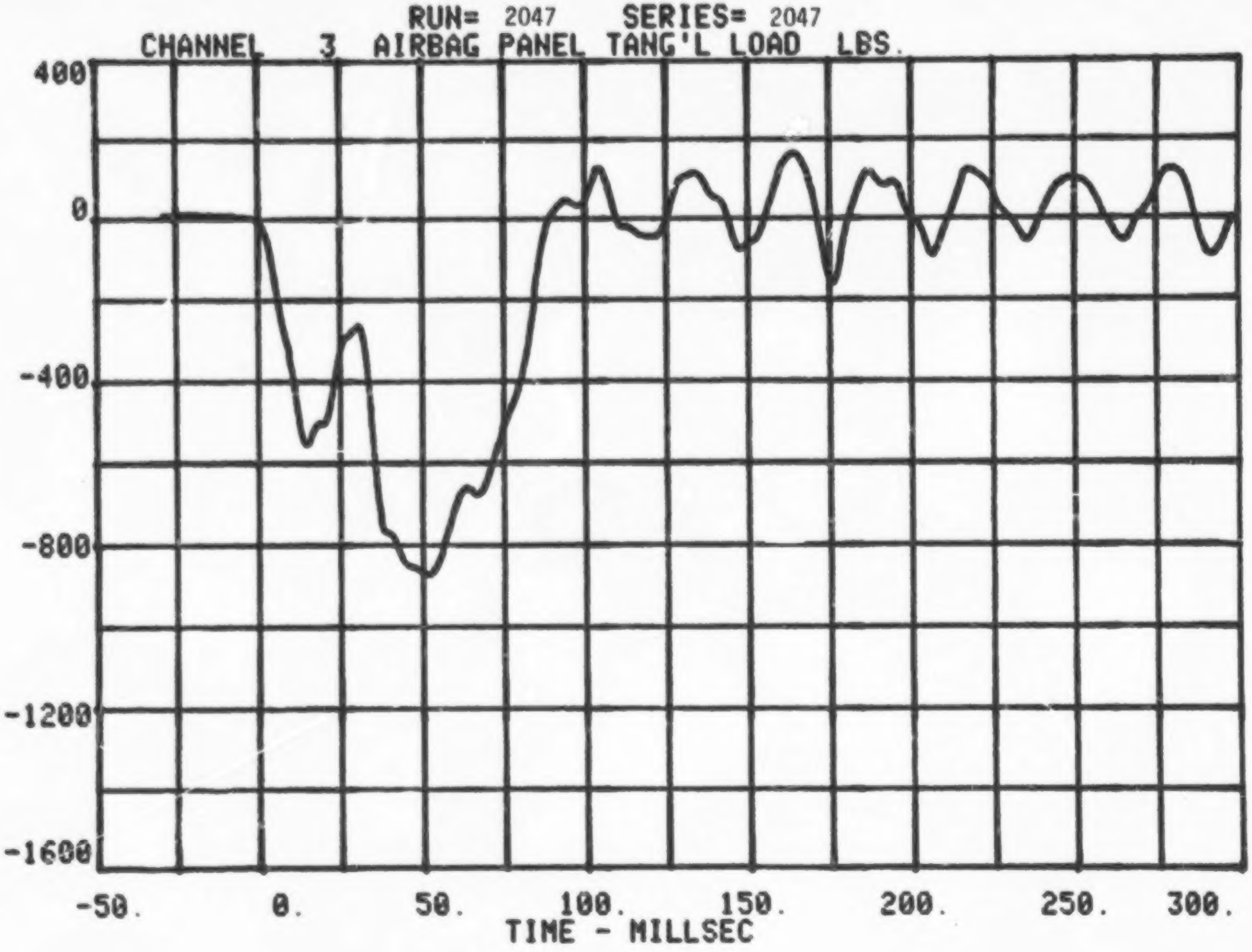

RUN= 2047 SERIES= 2047
CHANNEL 6 ABP LOWER LT NORMAL LD. LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2047 SERIES= 2047
CHANNEL 4 ABP LOWER RT NORMAL LD. LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

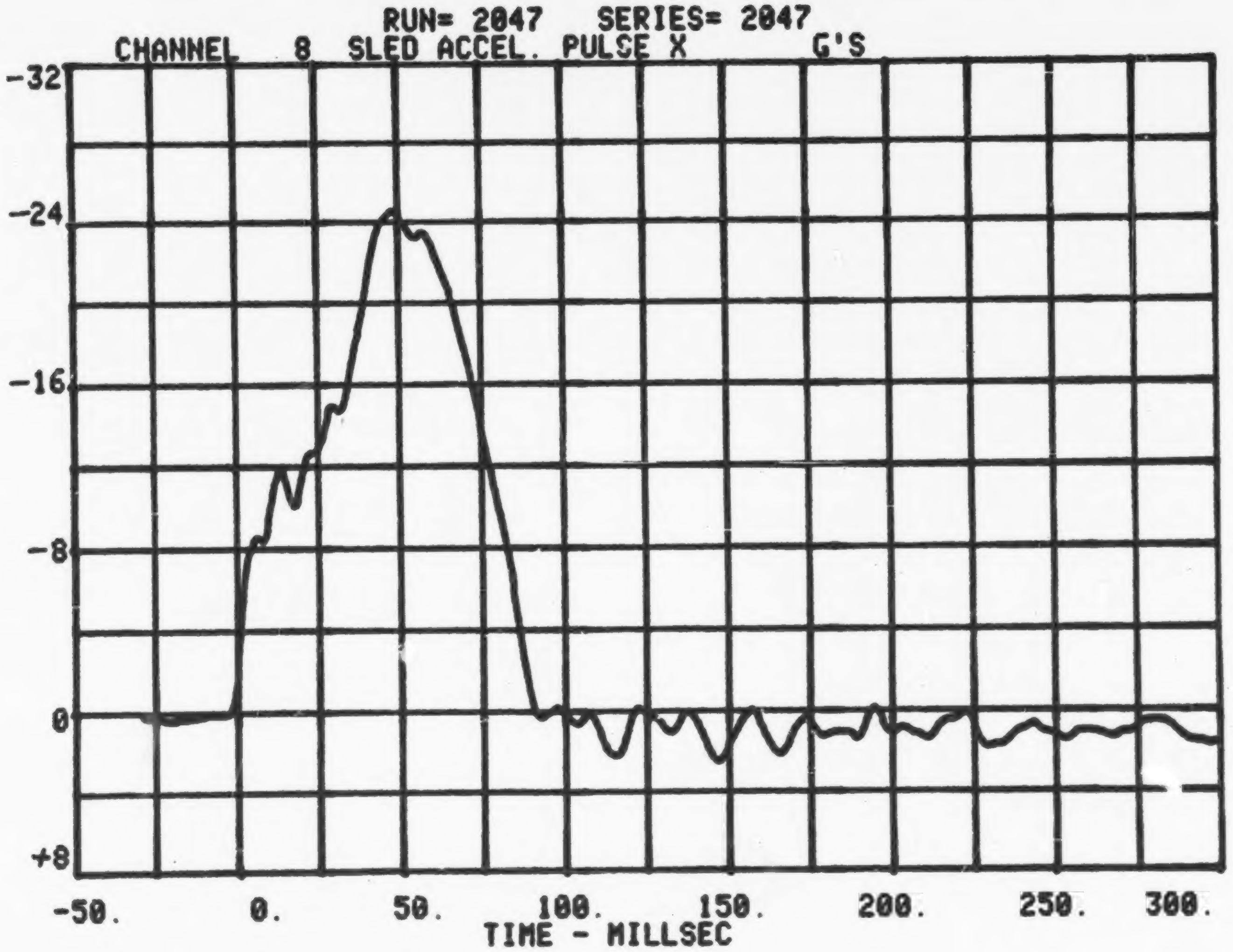

RUN= 2047 SERIES= 2047
CHANNEL 5 ABP TOP NORMAL LOAD LBS.
450
300
150
0
-150
-300
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



BEST DOCUMENT AVAILABLE



BEST DOCUMENT AVAILABLE


RUN= 2047 SERIES= 2047
CHANNEL 8 SLED ACCEL. PULSE X G'S
-32
-24
-16
-8
0
+8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

APPENDIX C

AIR BAG RESTRAINT SLED TEST 2044 DATA RECORDS

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Pelvis Accelerations	180
Arm Accelerations	180
Femur Loads	600
Contact Panel Loads	60
Bag Pressure	60
Sled Acceleration	60

Sequence of Data Records

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Pelvis - X, Y, Z, Resultant Accelerations

Left Arm - X, Y, Z, Resultant Accelerations

Right Arm - X, Y, Z, Resultant Accelerations

Femur Load - Left, Right

Seat Normal Load - Front Left, Front Right, Rear, Gross Sum, Net Sum

Seat Tangential Load - Gross, Net

Toeboard Normal Load - Gross, Net

Toeboard Tangential Load - Gross, Net

Knee Bolster Normal Load - Top Left, Top Right, Lower Center, Gross Sum, Net Sum

Knee Bolster Tangential Load - Gross, Net

Air Bag Panel Normal Load - Gross, Net

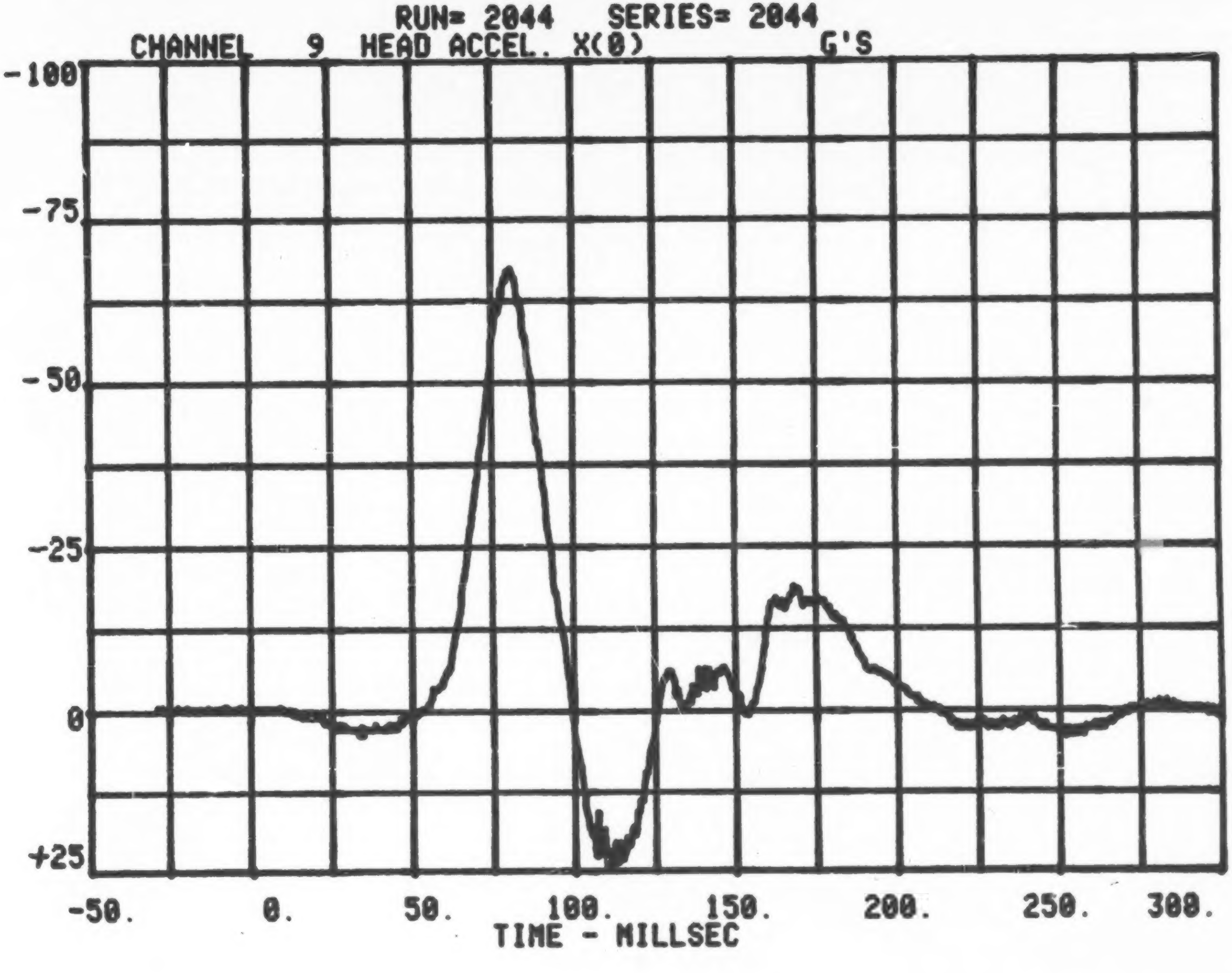
Air Bag Panel Tangential Load - Gross, Net

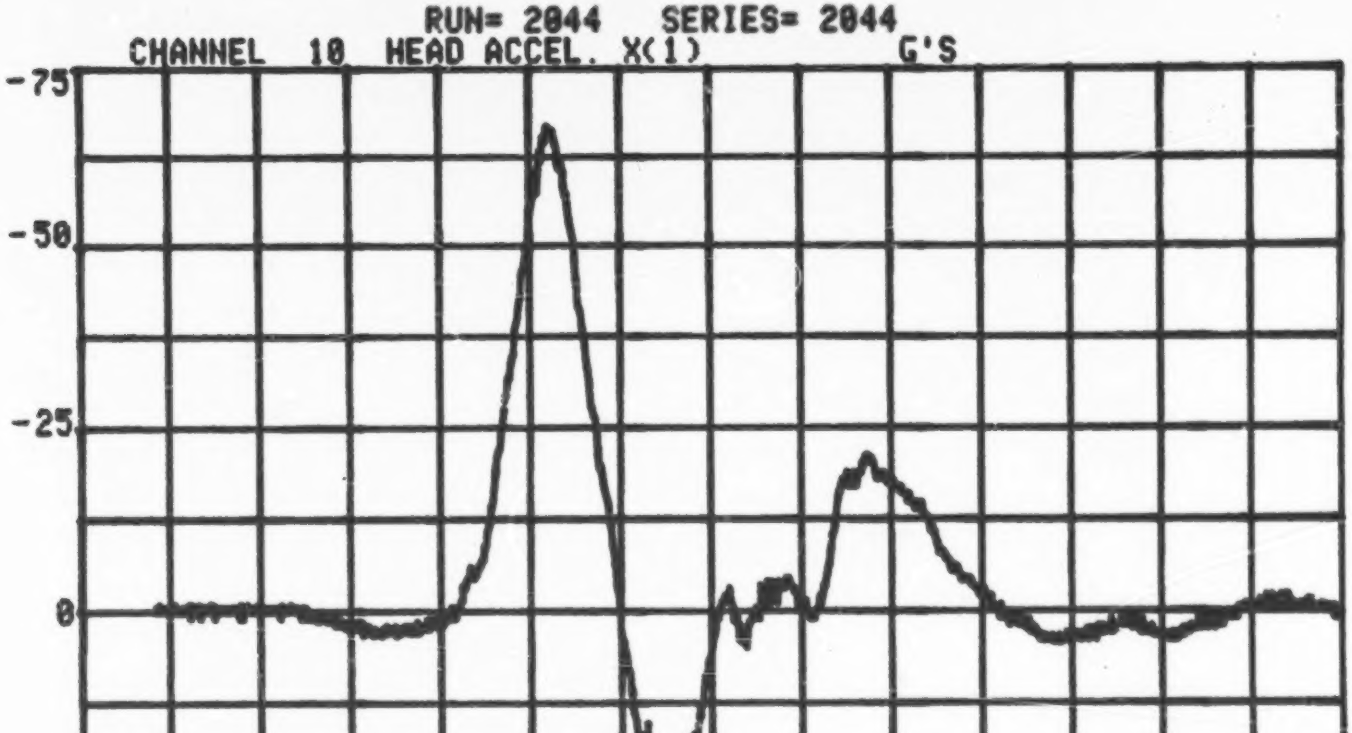
Air Bag Pressure

Sled Acceleration

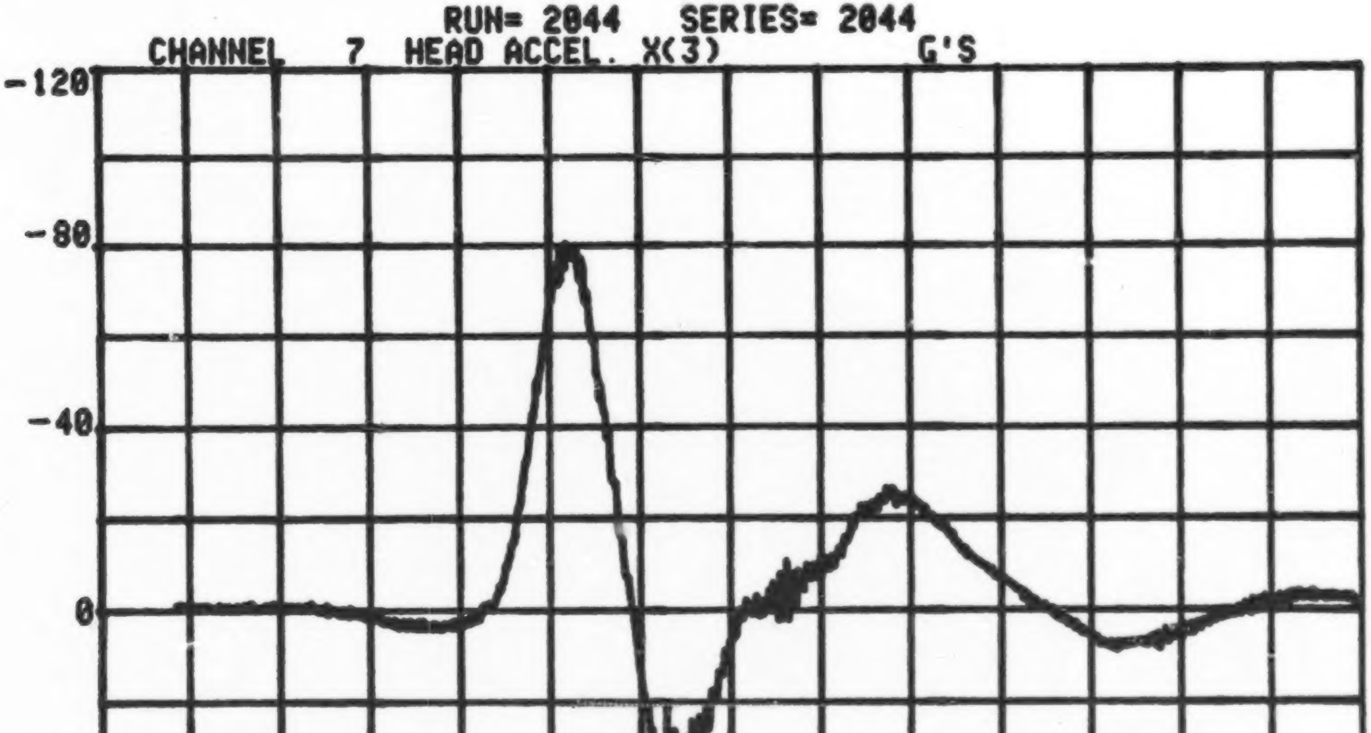
```
                  HEAD INJURY CRITERION
                   HEAD SEVERITY INDEX


               SLED TEST #2044

               RUN=2044

               RESULT. HEAD ACCEL.

      HIC= 680.1   FROM T1= .06780   TO T2= .11550

      AVERAGE ACCELERATION BETWEEN T1 AND T2=  45.9G'S

      EVENT TIME= 300.0  MSEC

      SEVERITY INDEX= 983.9
```

BEST DOCUMENT AVAILABLE

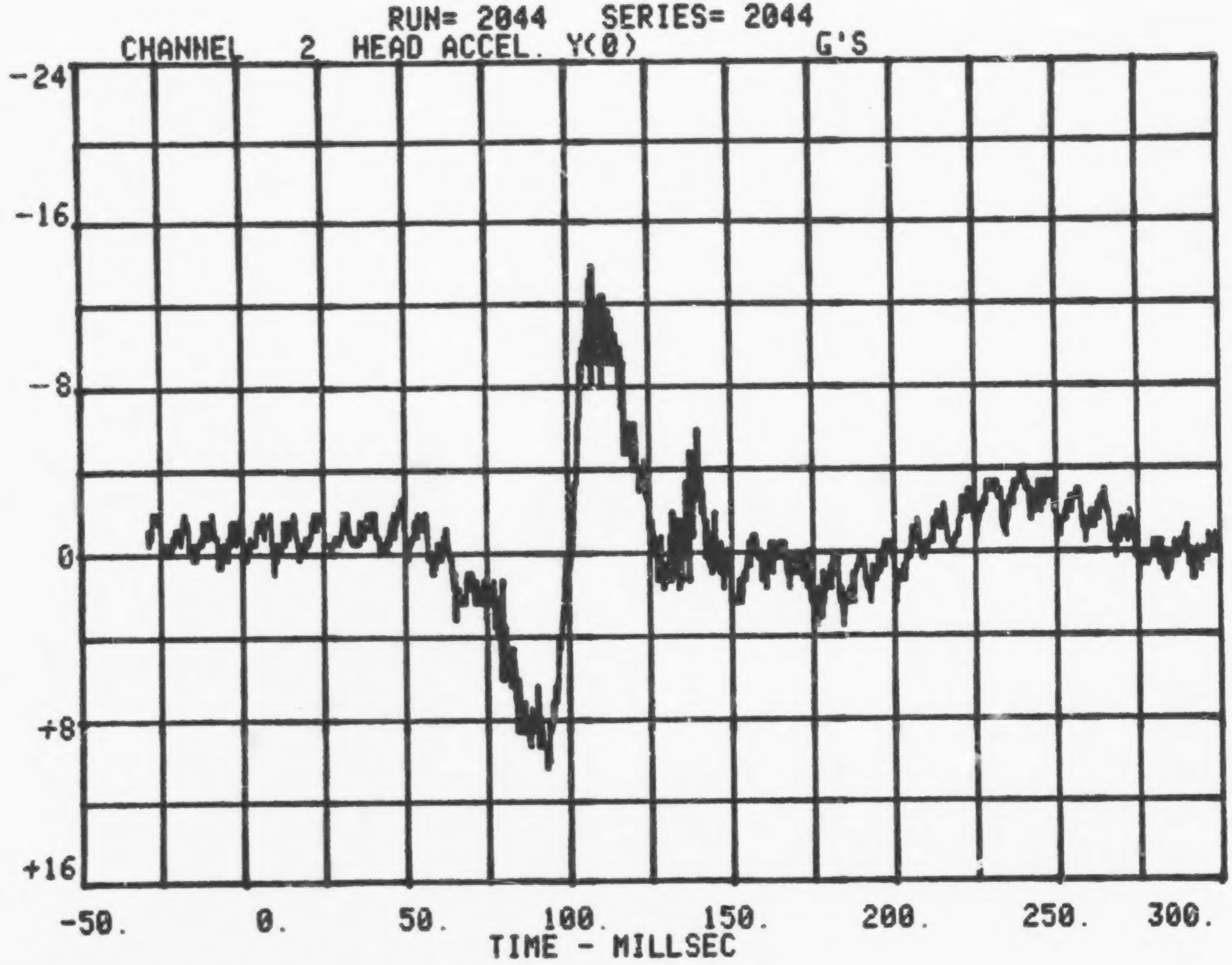

RUN= 2044 SERIES= 2044
CHANNEL 9 HEAD ACCEL. X(0) G'S
-100
-75
-50
-25
0
+25
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

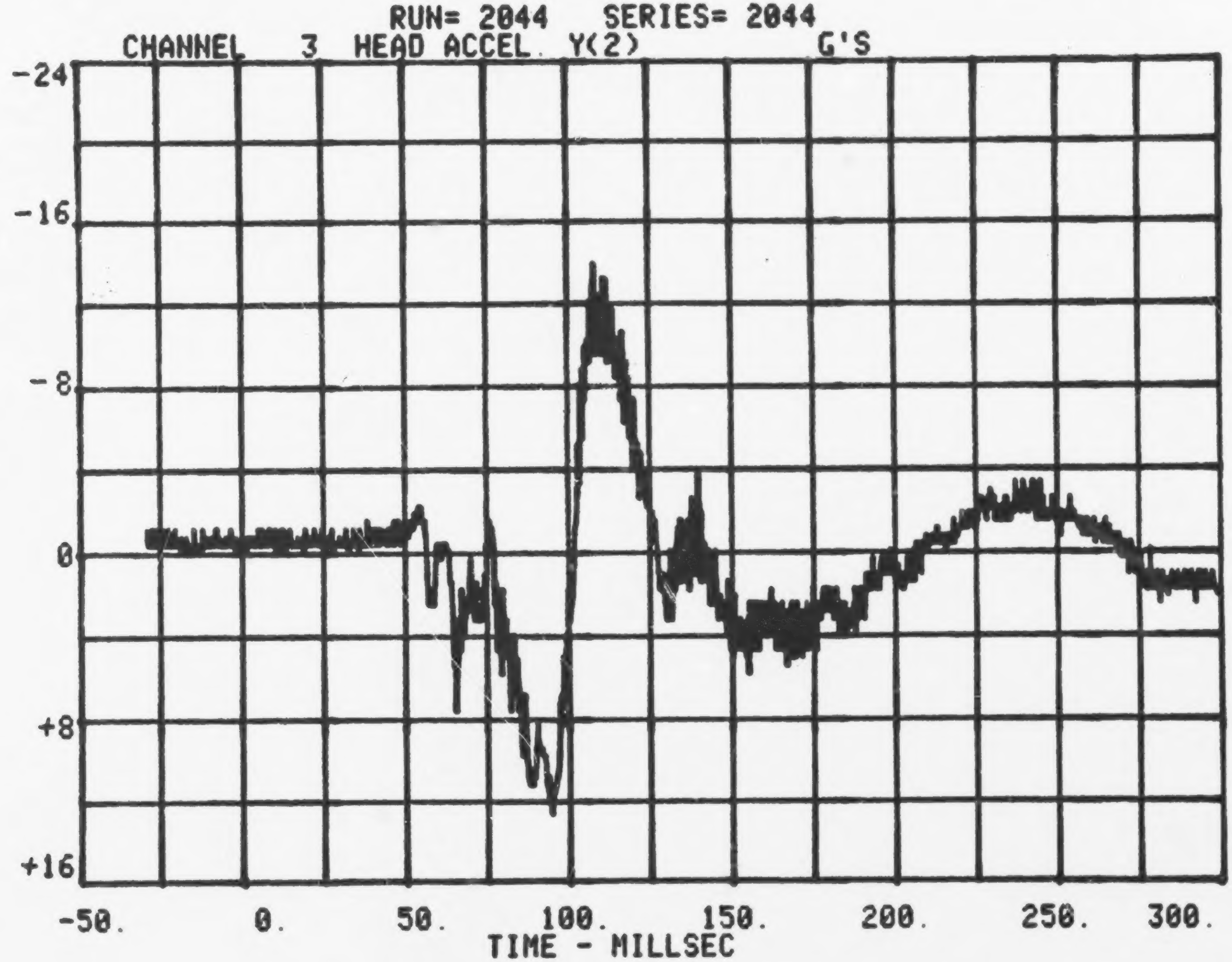


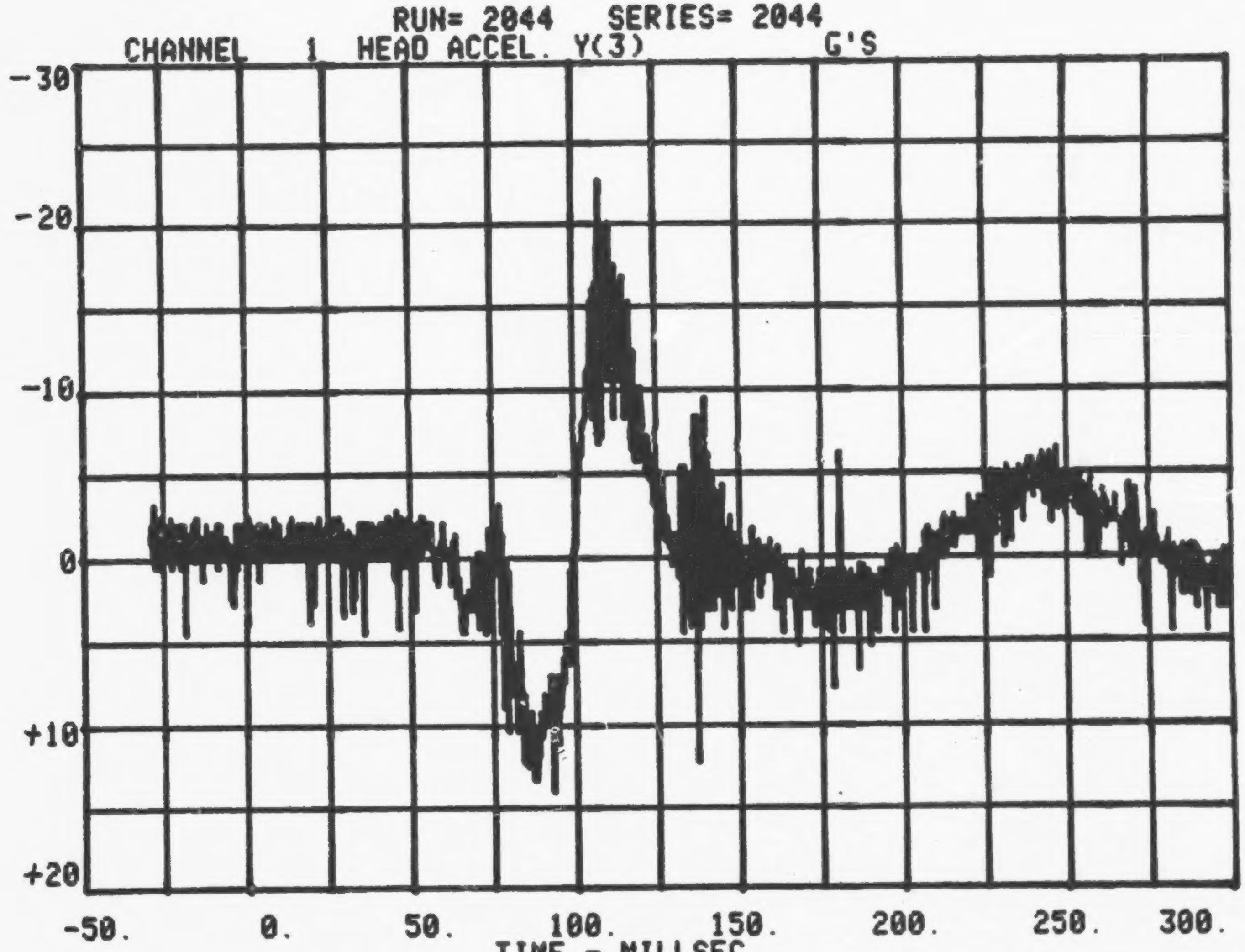
BEST DOCUMENT AVAILABLE

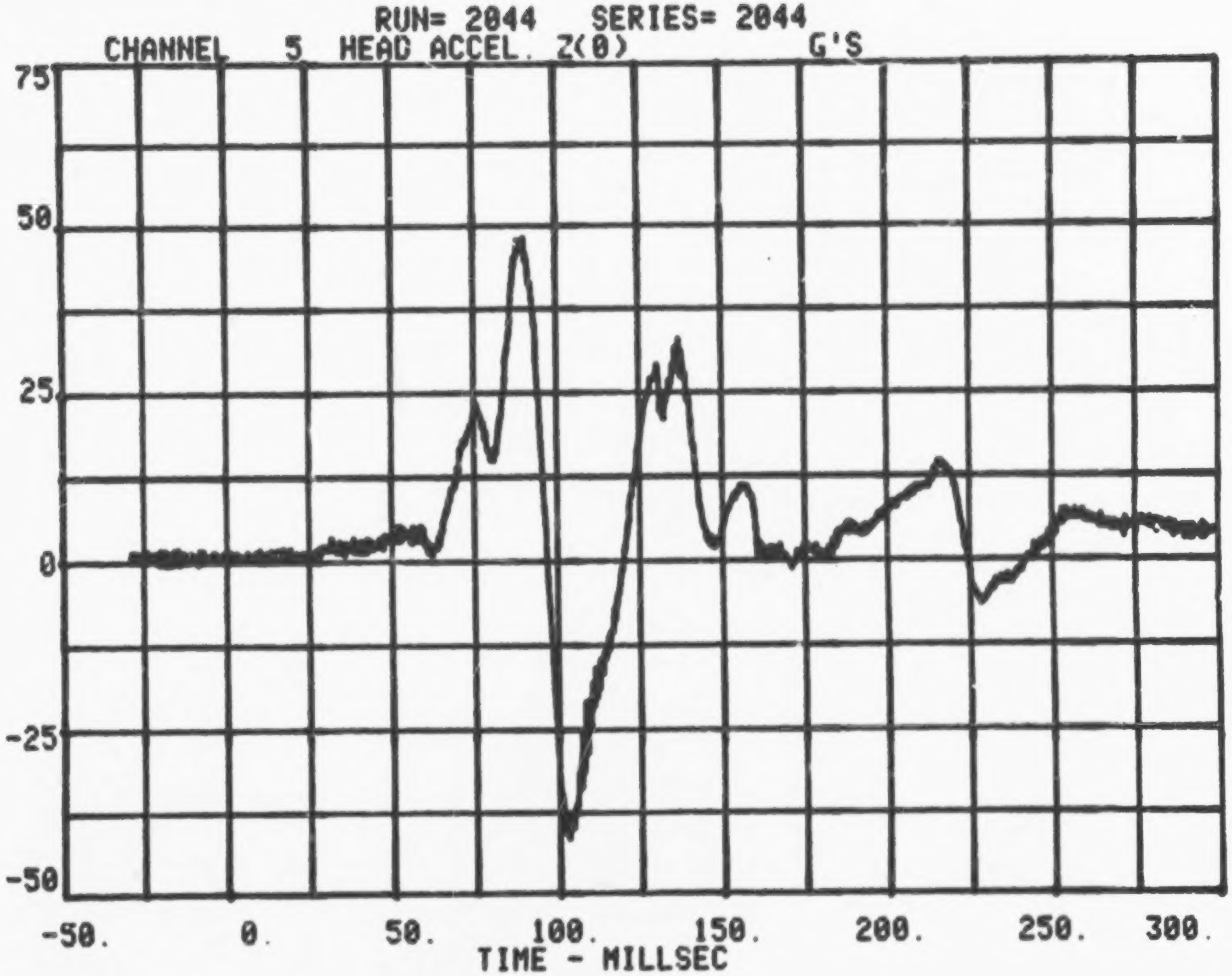


BEST DOCUMENT AVAILABLE


RUN= 2044 SERIES= 2044
CHANNEL 2 HEAD ACCEL. Y(0) G'S
-24
-16
-8
0
+8
+16
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

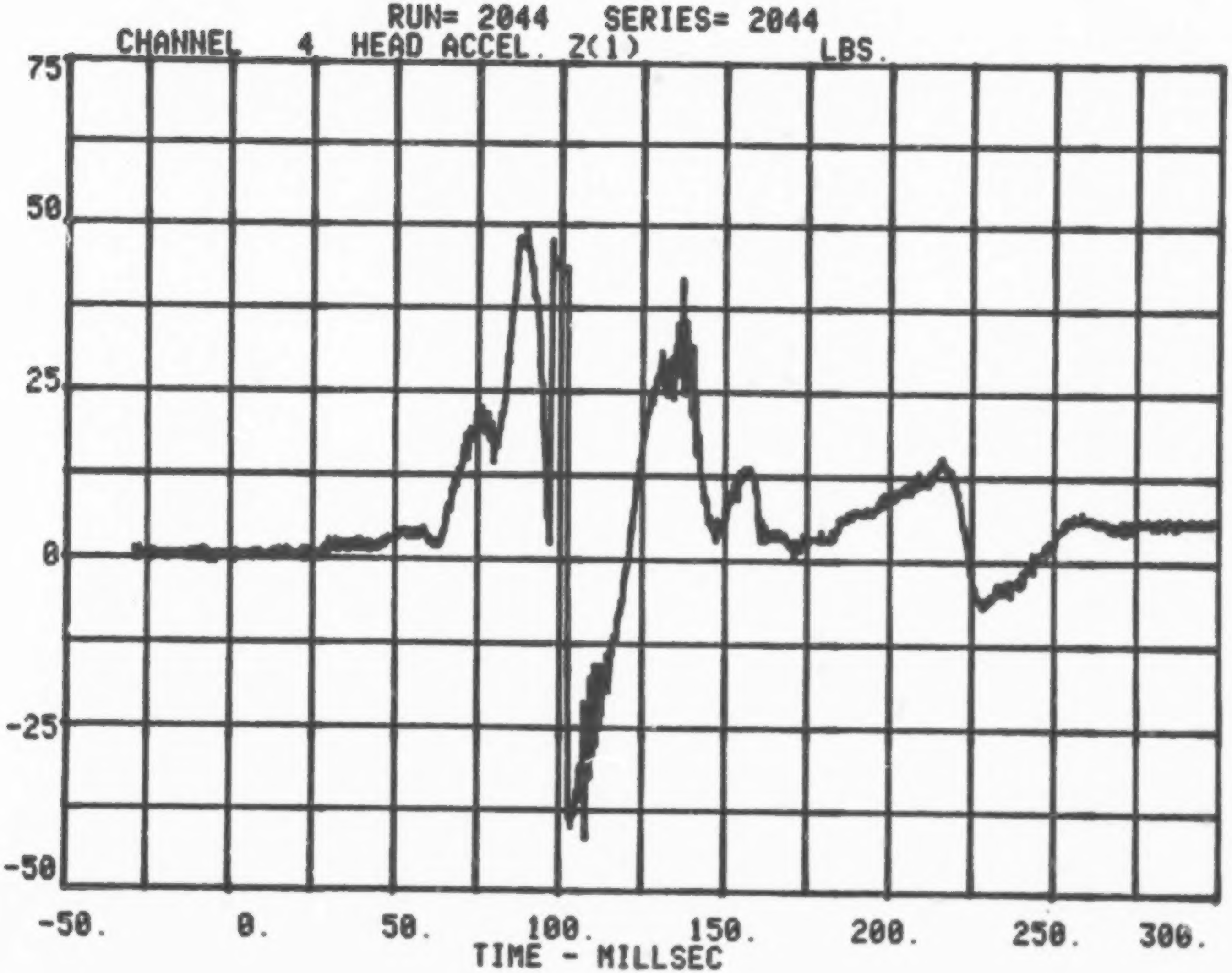

RUN= 2044 SERIES= 2044
CHANNEL 3 HEAD ACCEL Y(2) G'S
-24
-16
-8
0
+8
+16
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

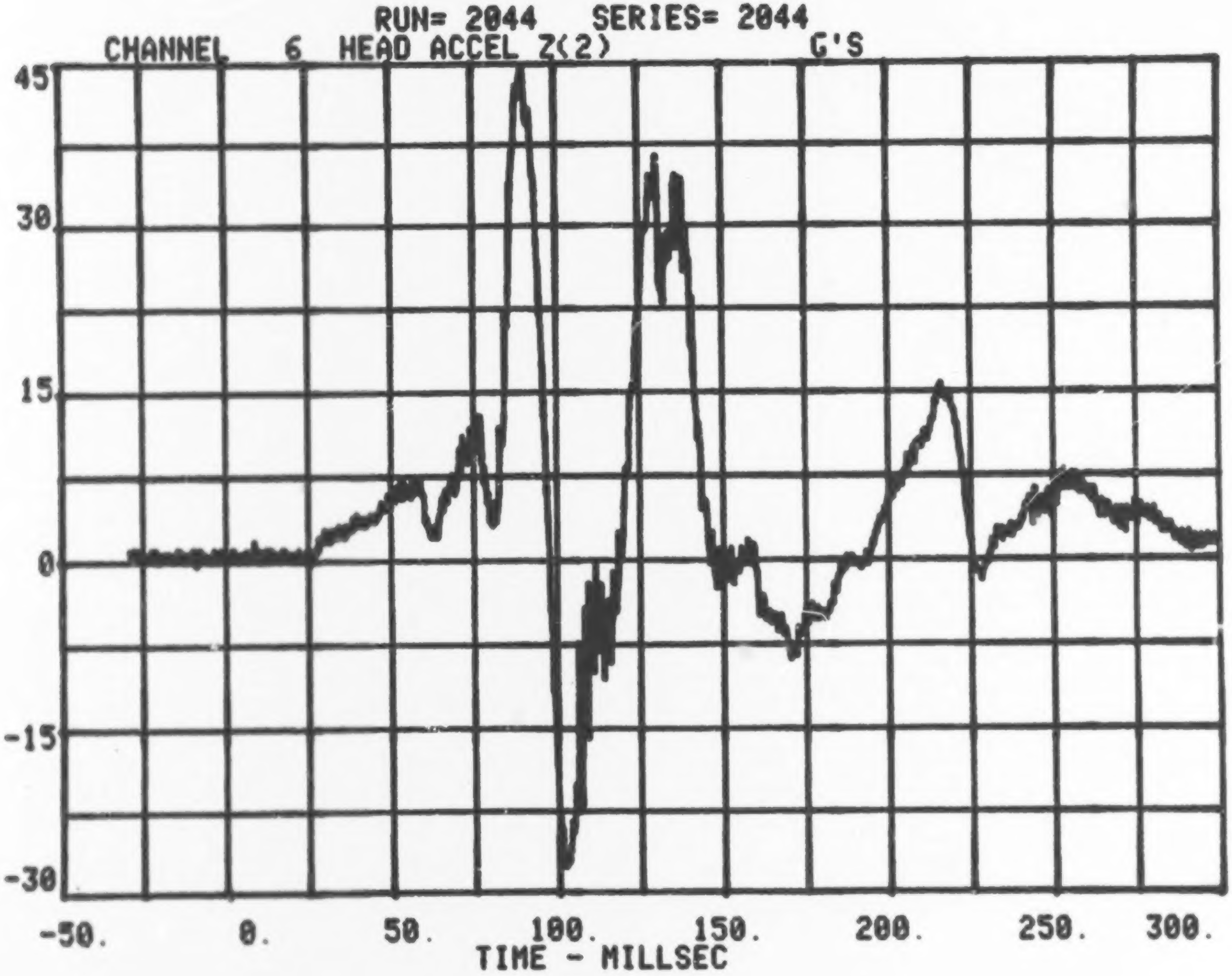

RUN= 2044 SERIES= 2044
CHANNEL 1 HEAD ACCEL. Y(3) G'S
-30
-20
-10
0
+10
+20
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

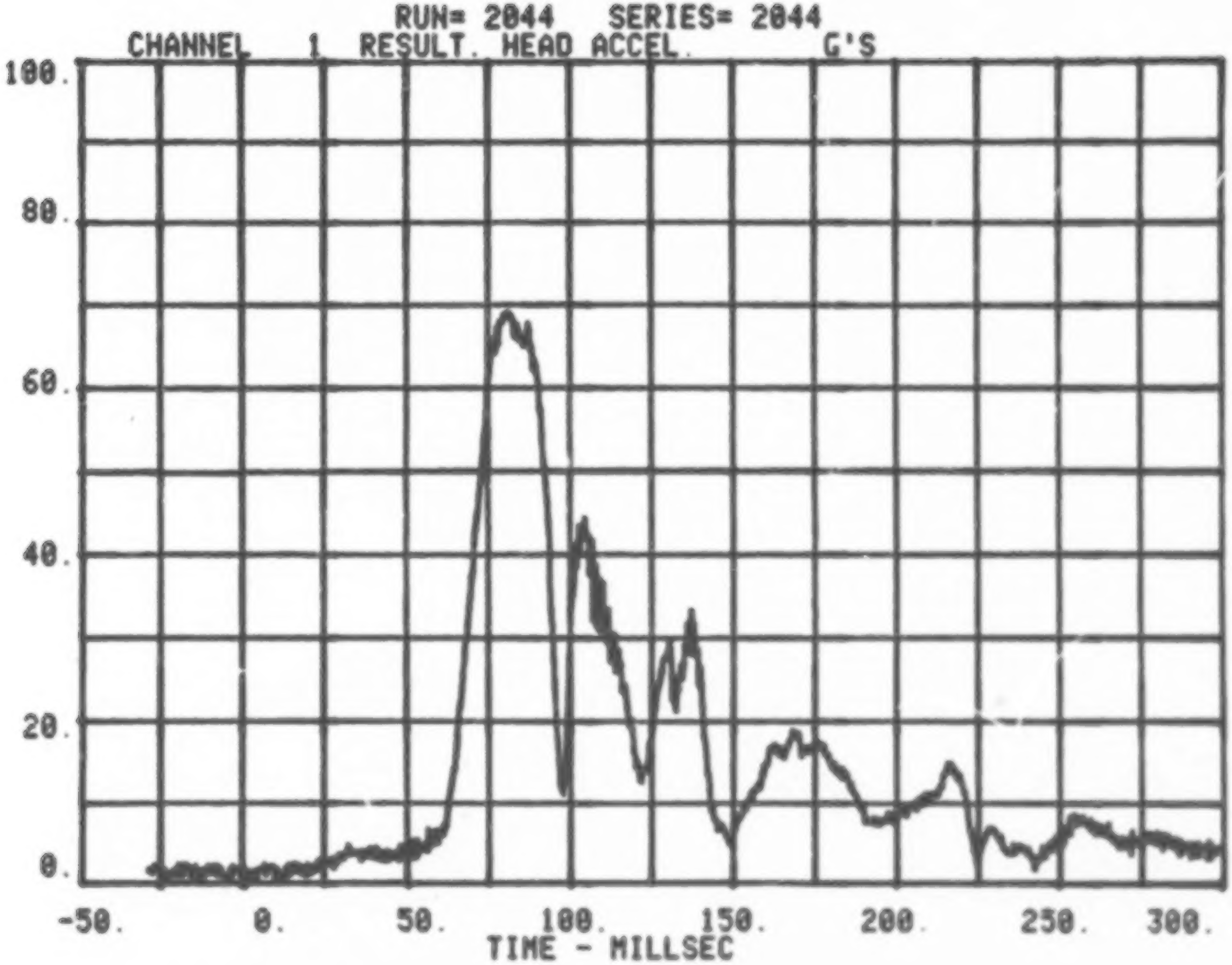


RUN= 2044 SERIES= 2044

CHANNEL 5 HEAD ACCEL. Z(0) G'S

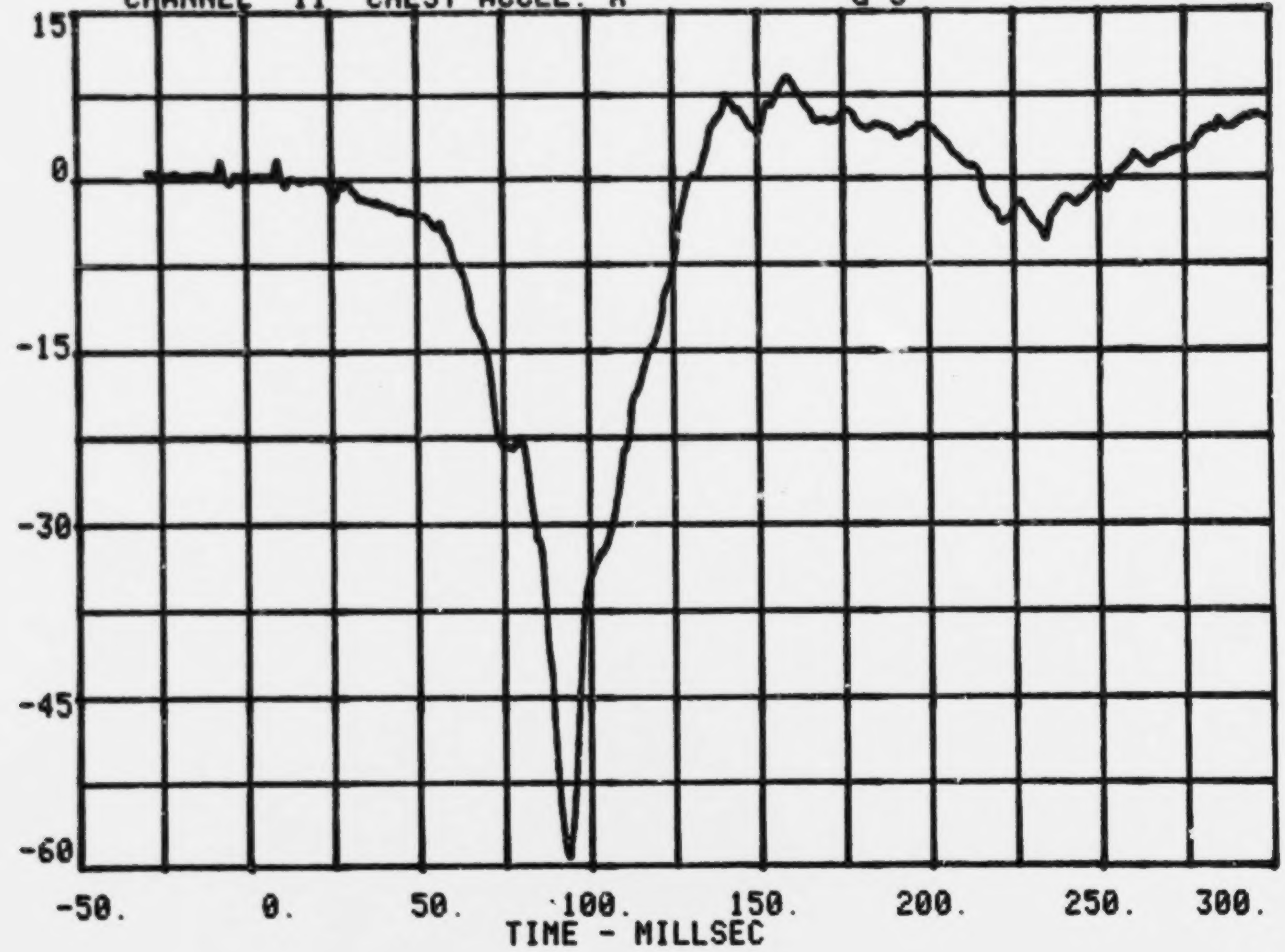

RUN= 2044 SERIES= 2044
CHANNEL 4 HEAD ACCEL. Z(1) LBS.
75
50
25
0
-25
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

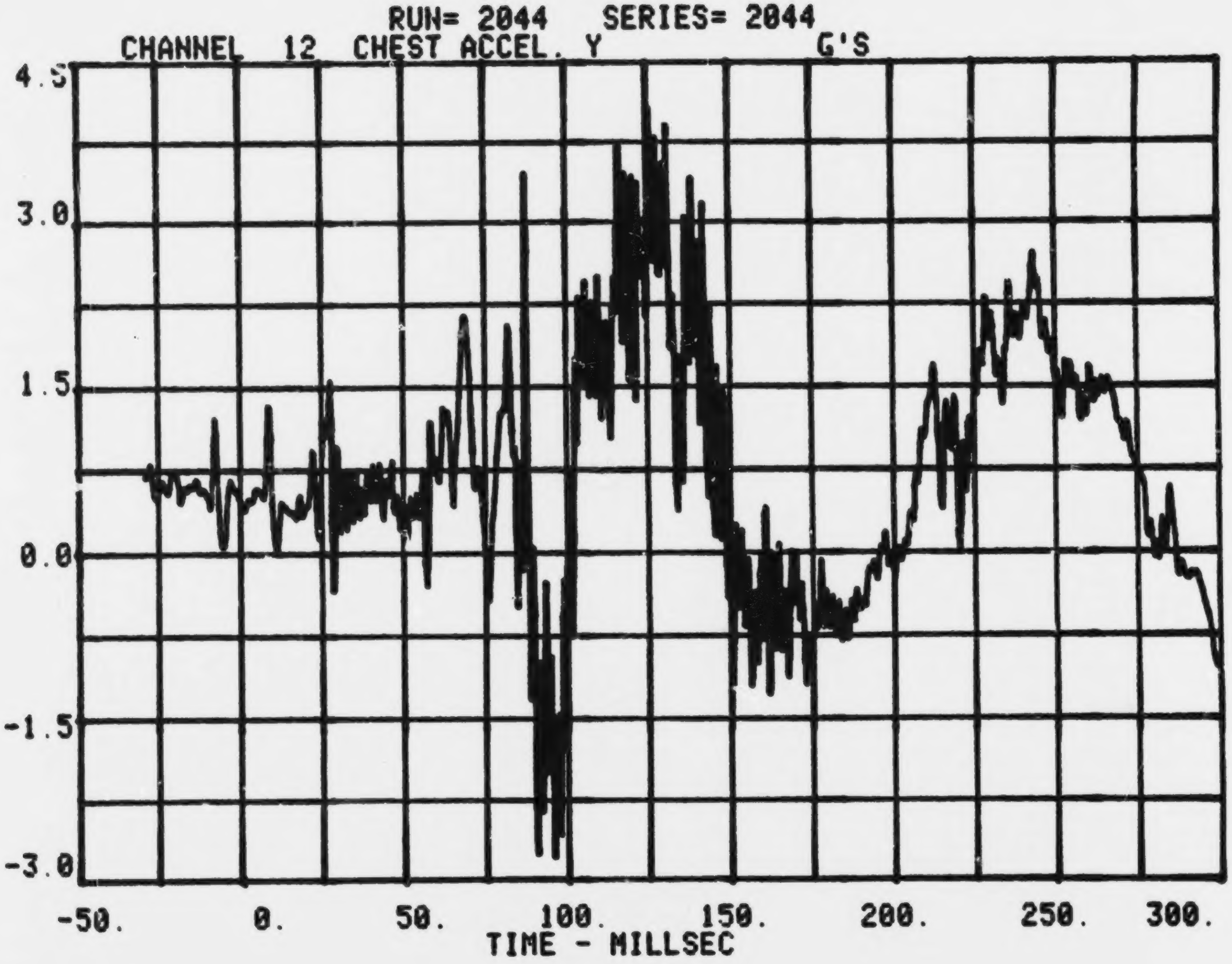

RUN= 2044 SERIES= 2044
CHANNEL 6 HEAD ACCEL Z(2) G'S
45
30
15
0
-15
-30
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2044 SERIES= 2044
CHANNEL 1 RESULT. HEAD ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

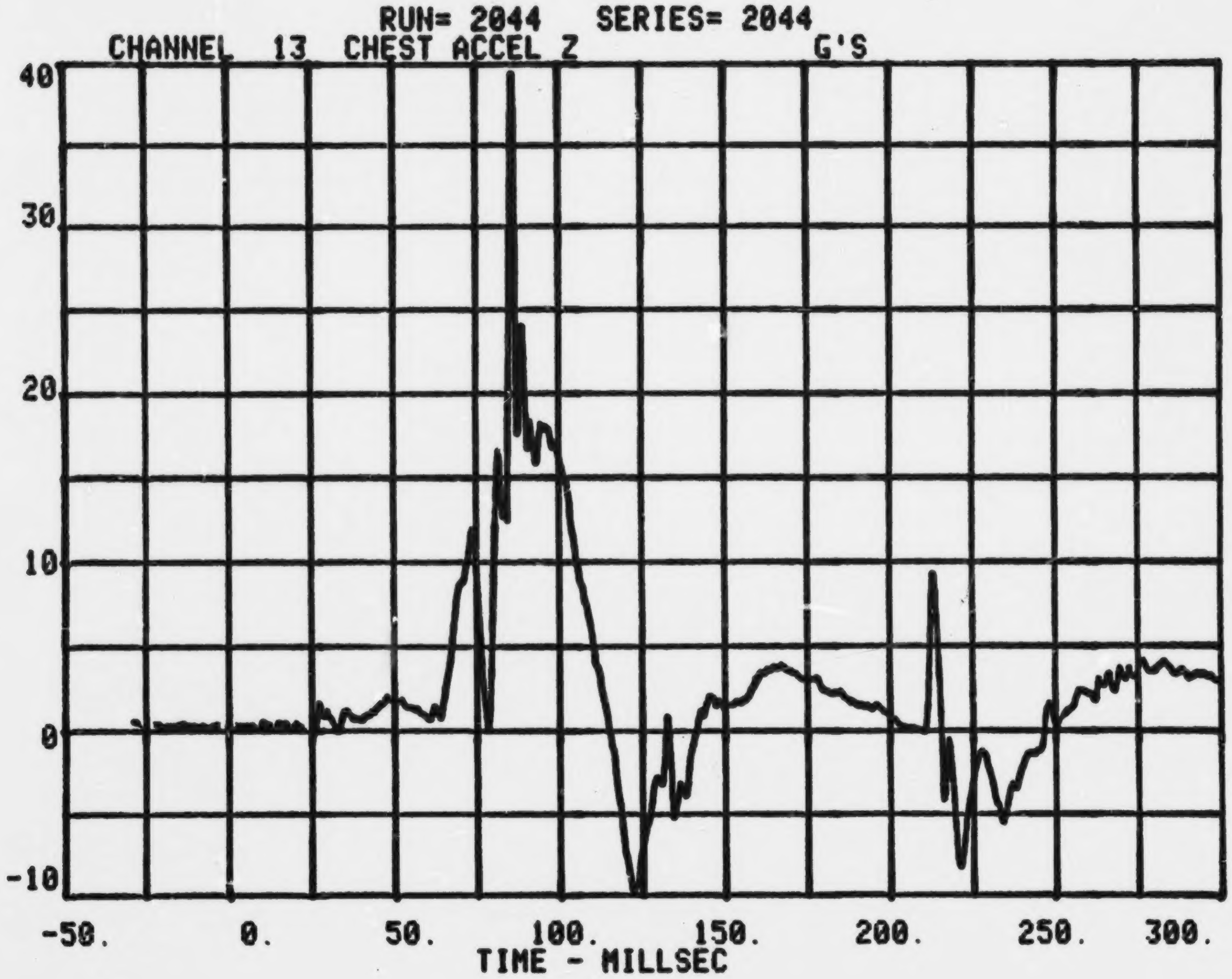
RUN= 2044   SERIES= 2044

CHANNEL 11 CHEST ACCEL. X   G'S

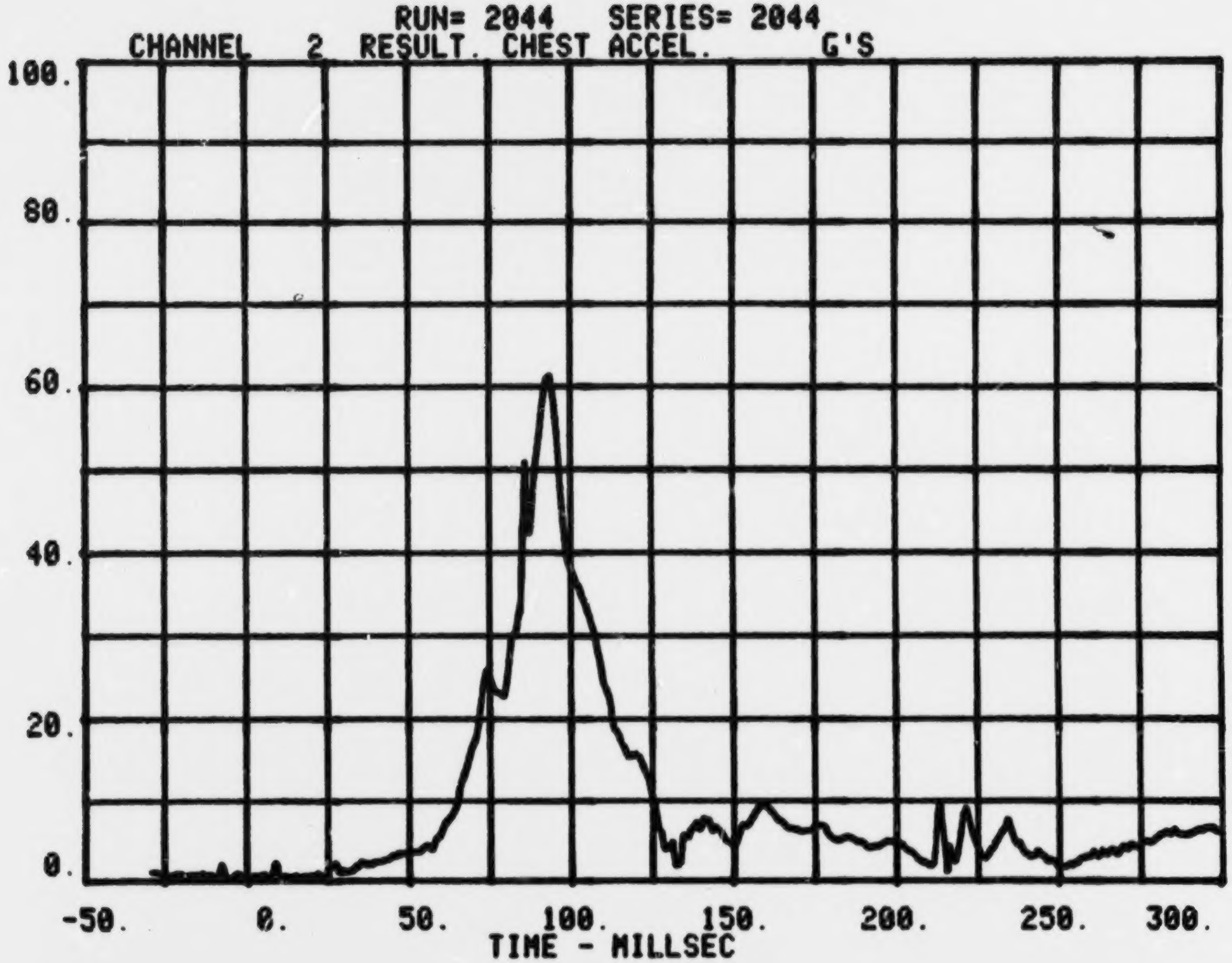




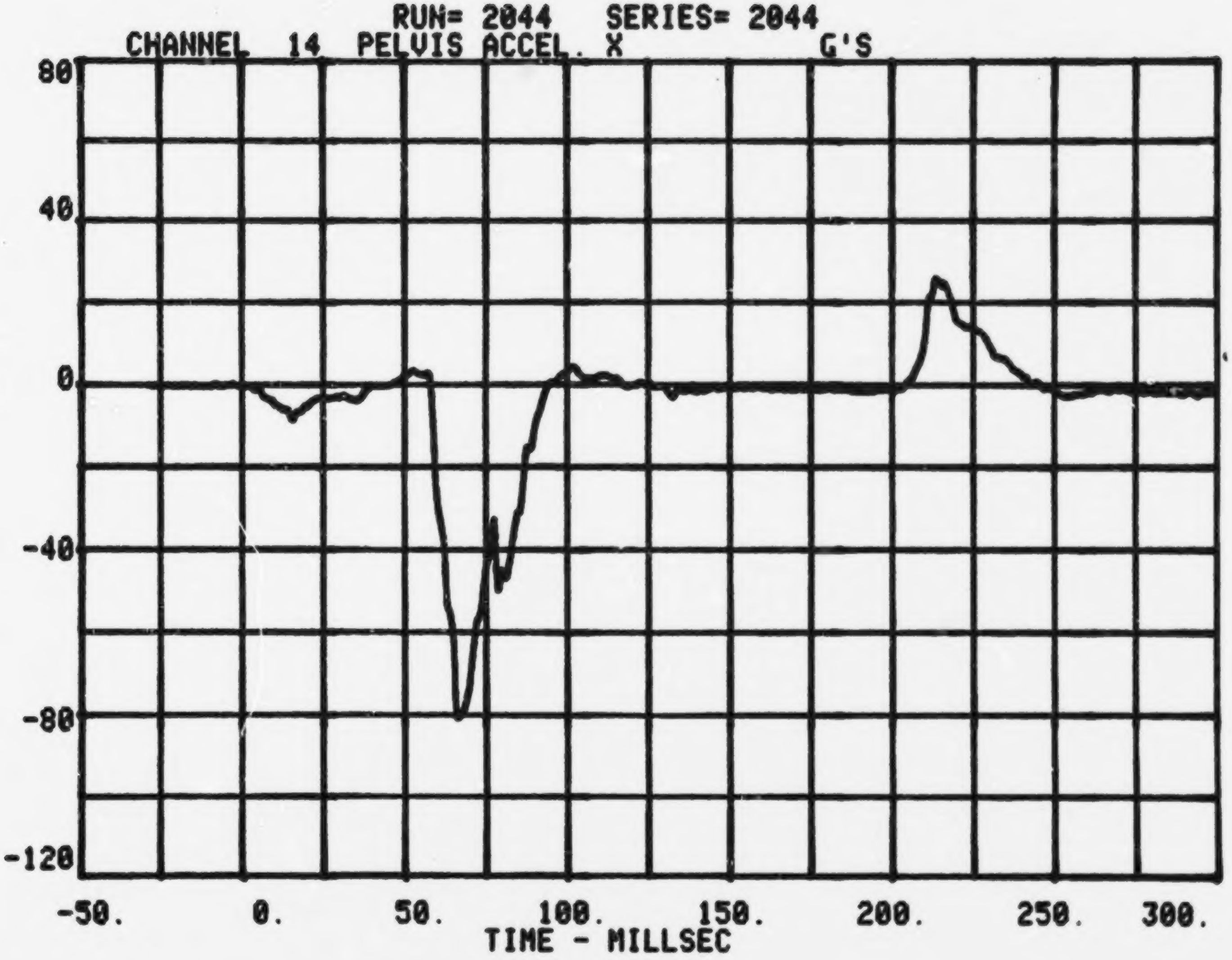
BEST DOCUMENT AVAILABLE



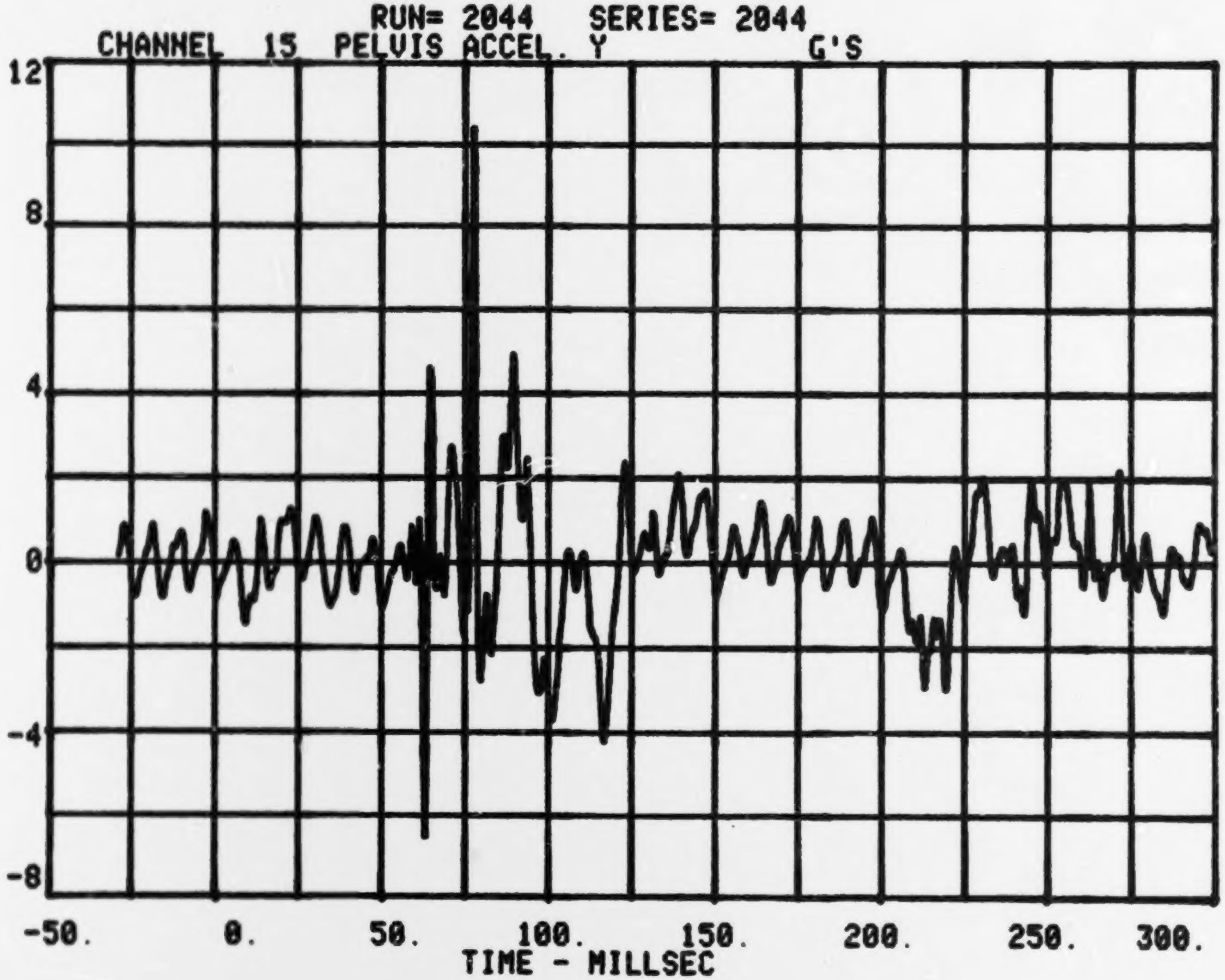
BEST DOCUMENT AVAILABLE

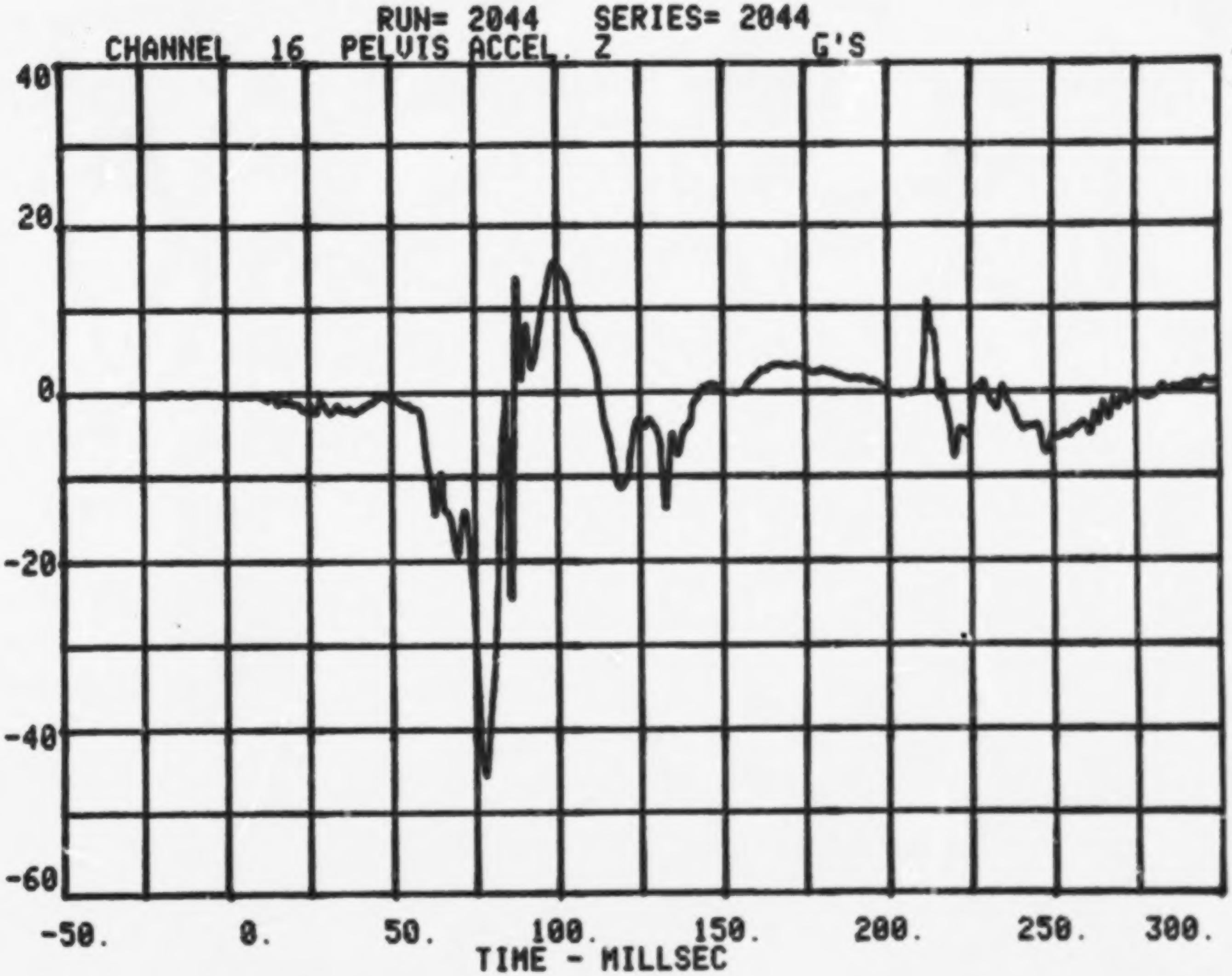


BEST DOCUMENT AVAILABLE

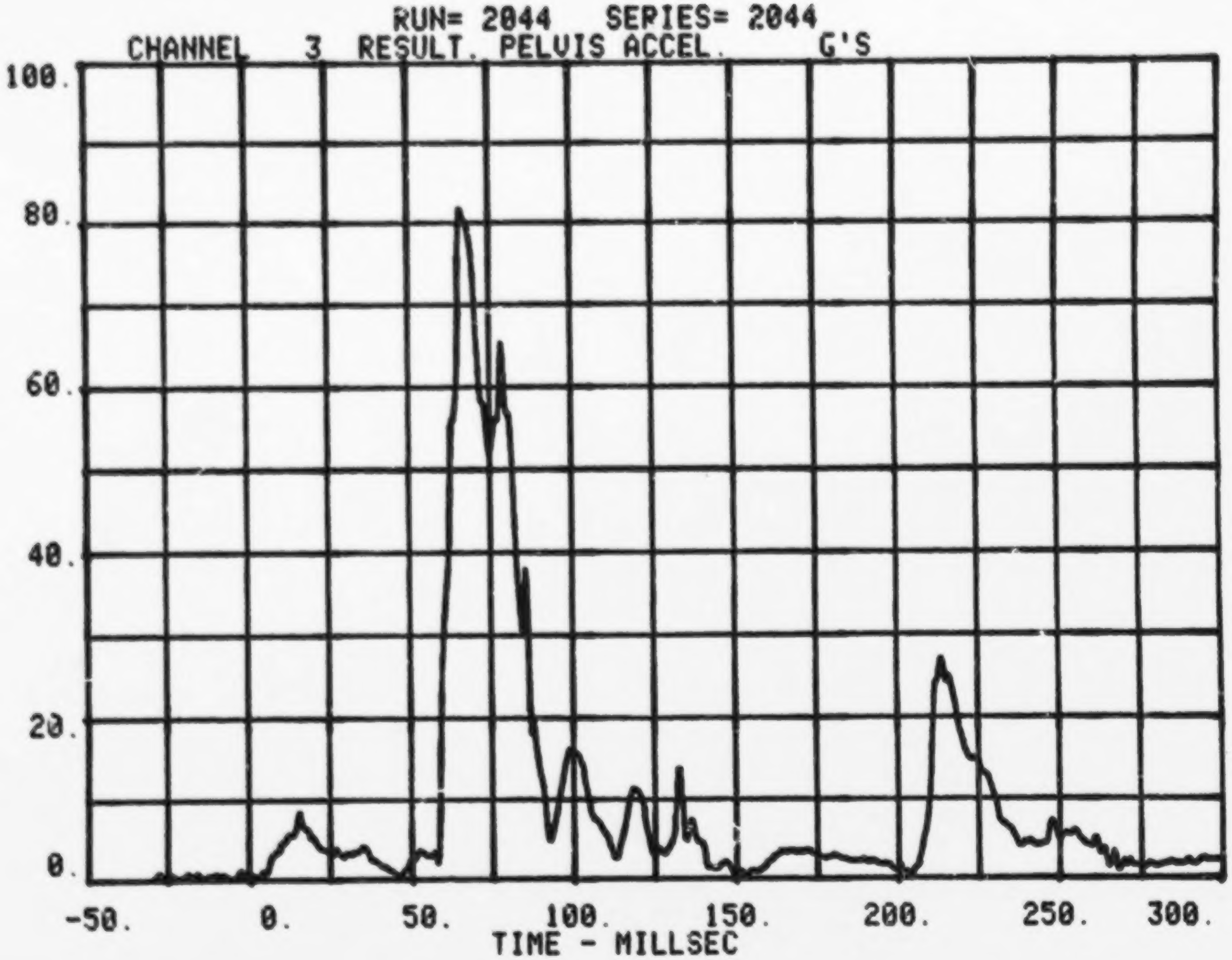


BEST DOCUMENT AVAILABLE


RUN= 2044 SERIES= 2044
CHANNEL 15 PELVIS ACCEL. Y G'S
12
8
4
0
-4
-8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

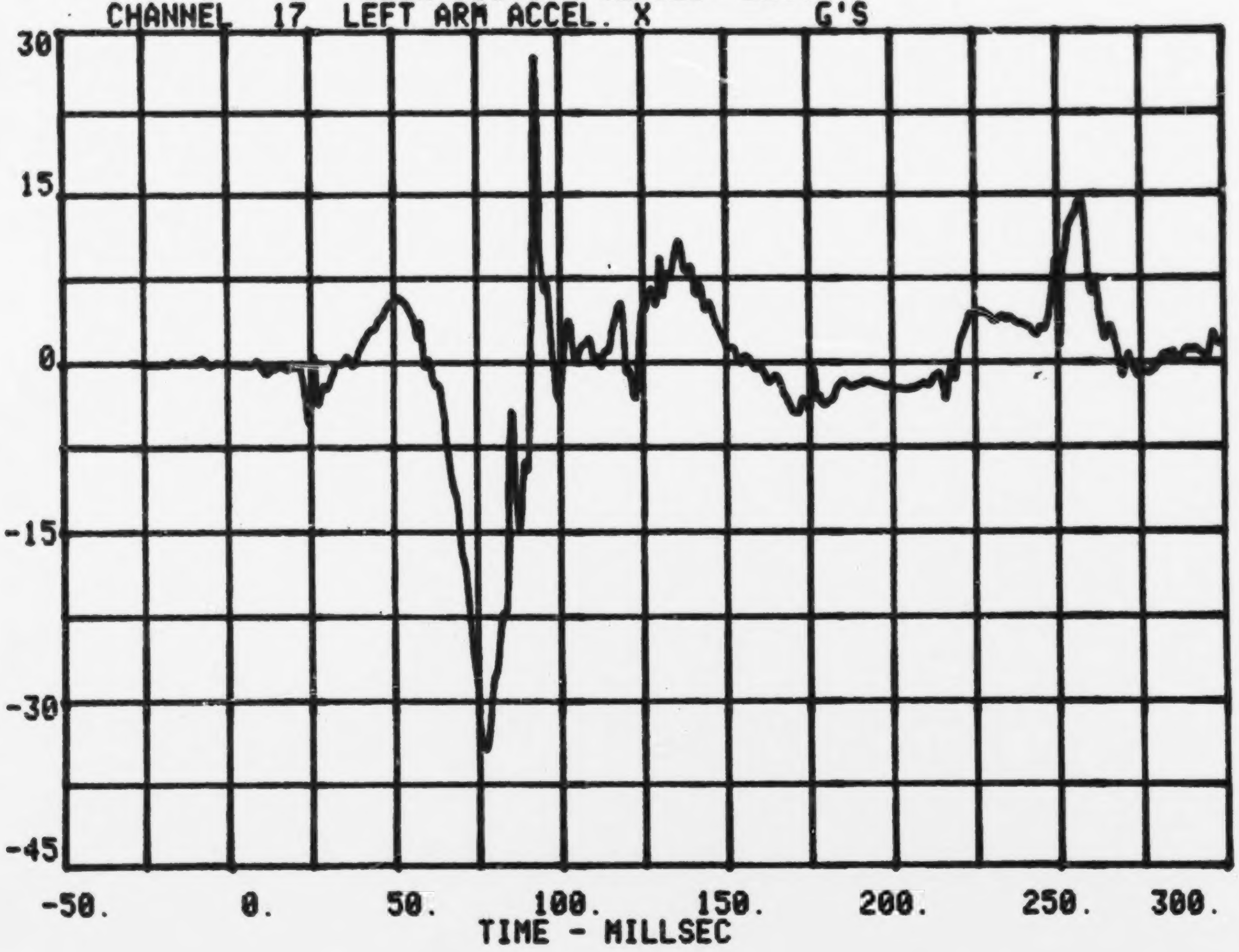


BEST DOCUMENT AVAILABLE

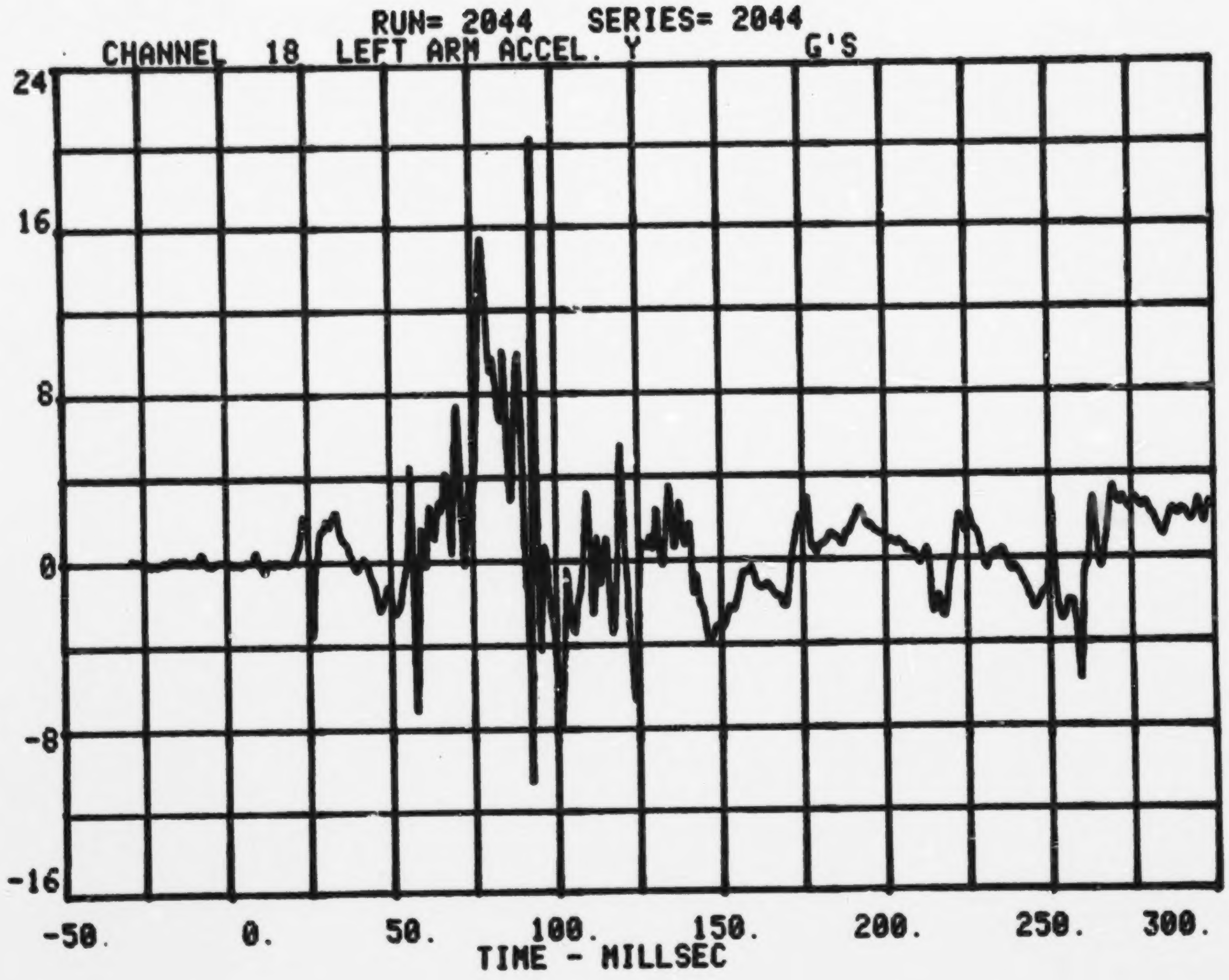

RUN= 2044 SERIES= 2044

CHANNEL 3 RESULT. PELVIS ACCEL. G'S

RUN= 2044 SERIES= 2044
CHANNEL 17 LEFT ARM ACCEL. X G'S



BEST DOCUMENT AVAILABLE

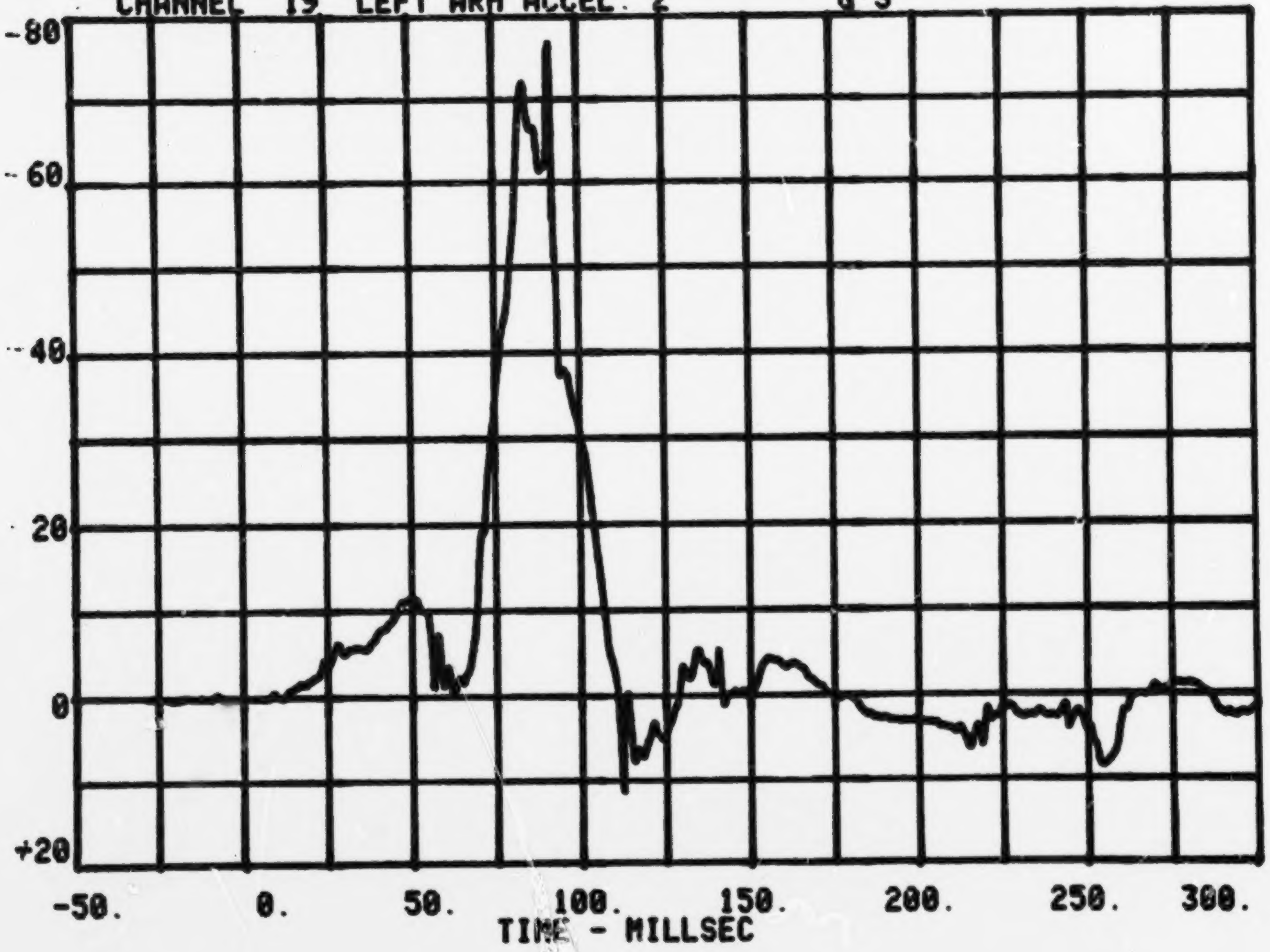


BEST DOCUMENT AVAILABLE

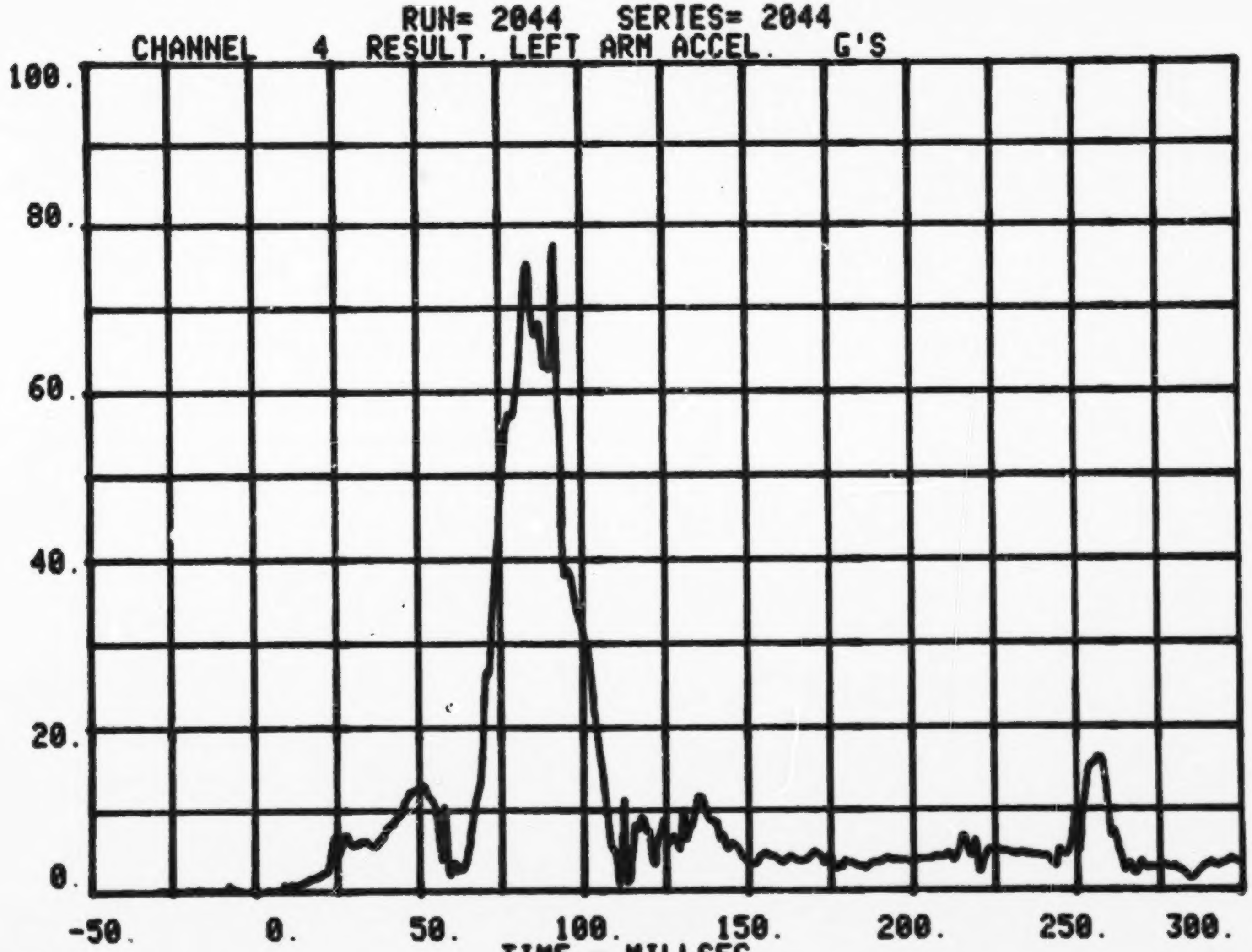
124

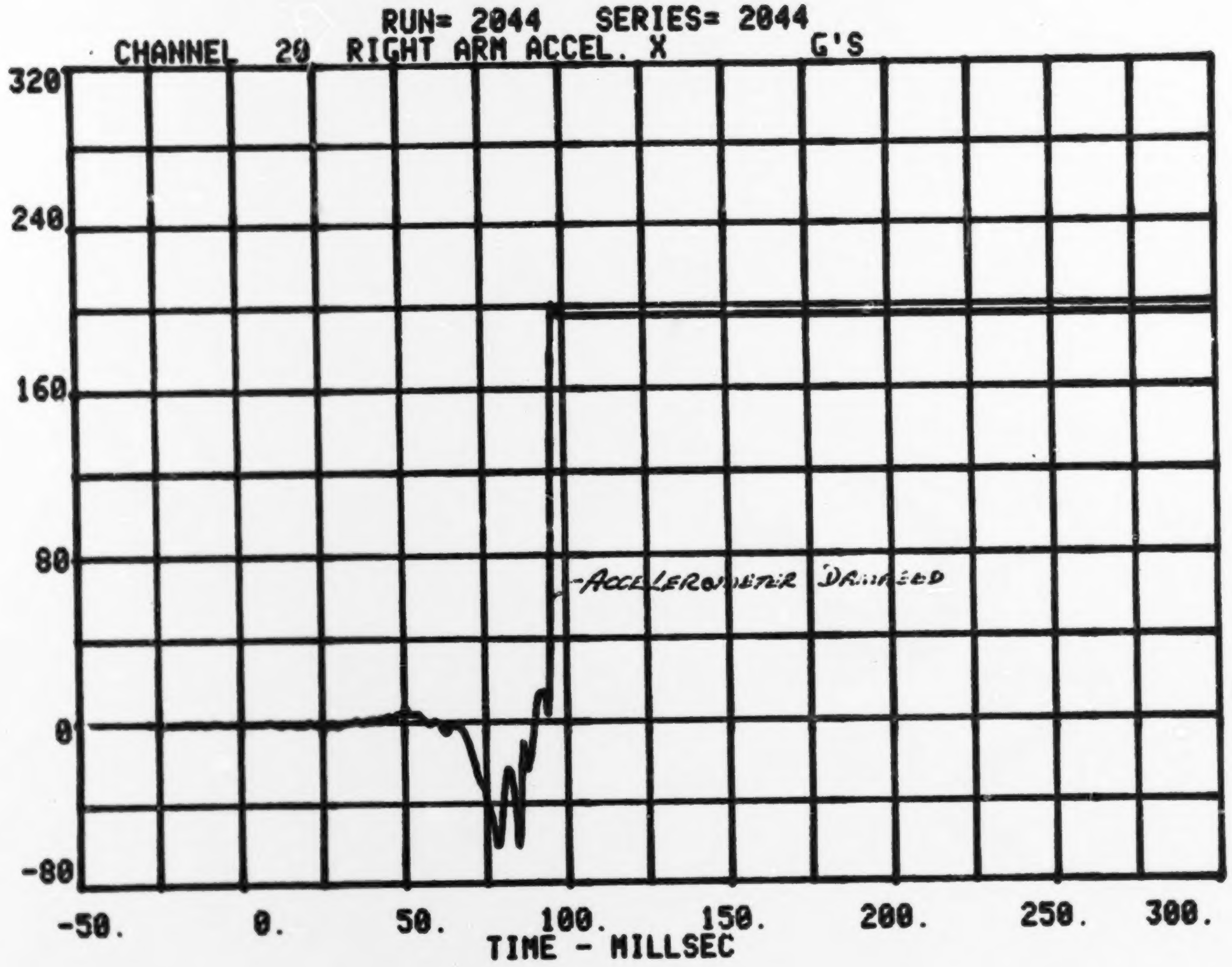
RUN= 2044 SERIES= 2044

CHANNEL 19 LEFT ARM ACCEL Z G'S



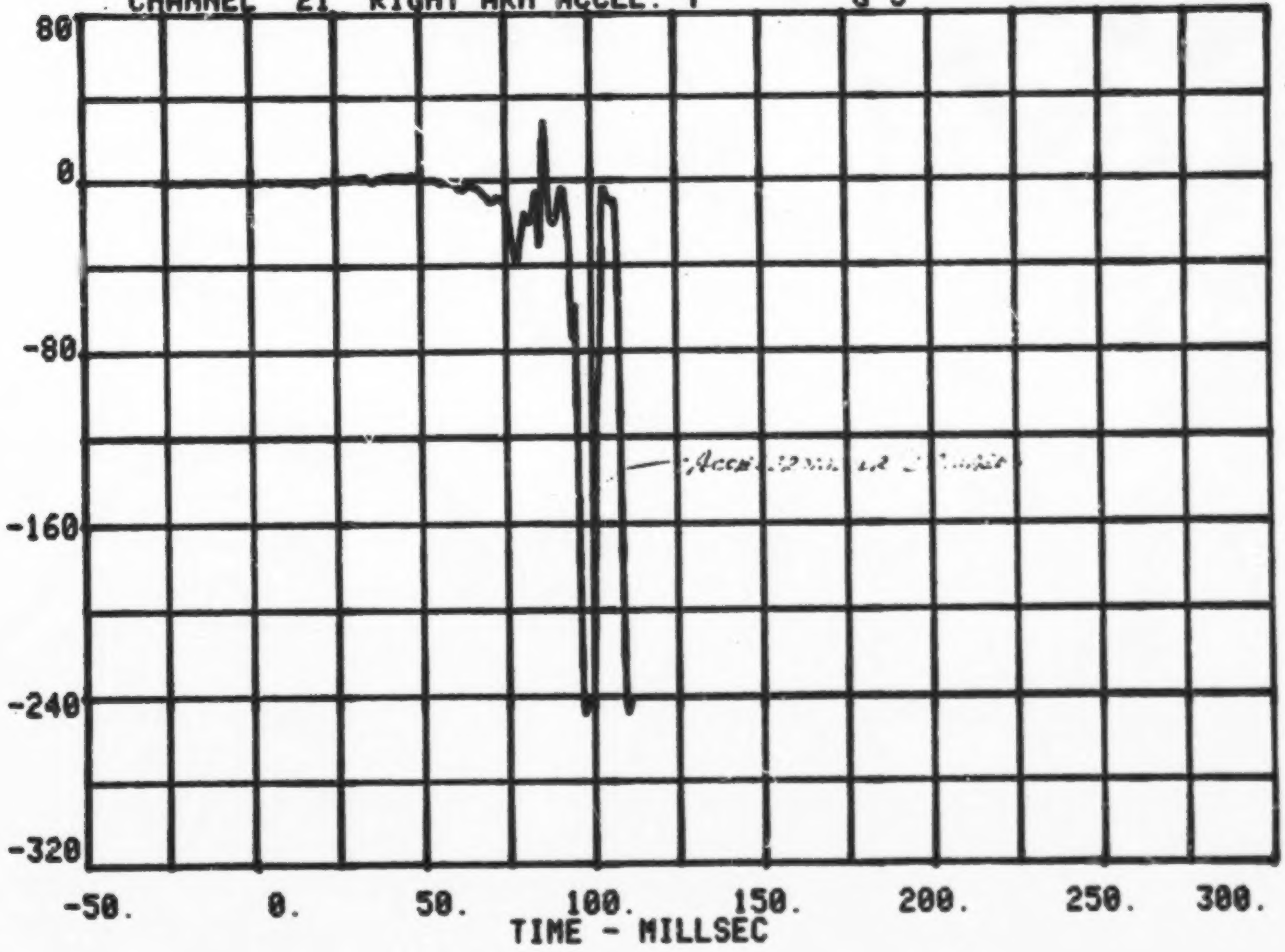
125

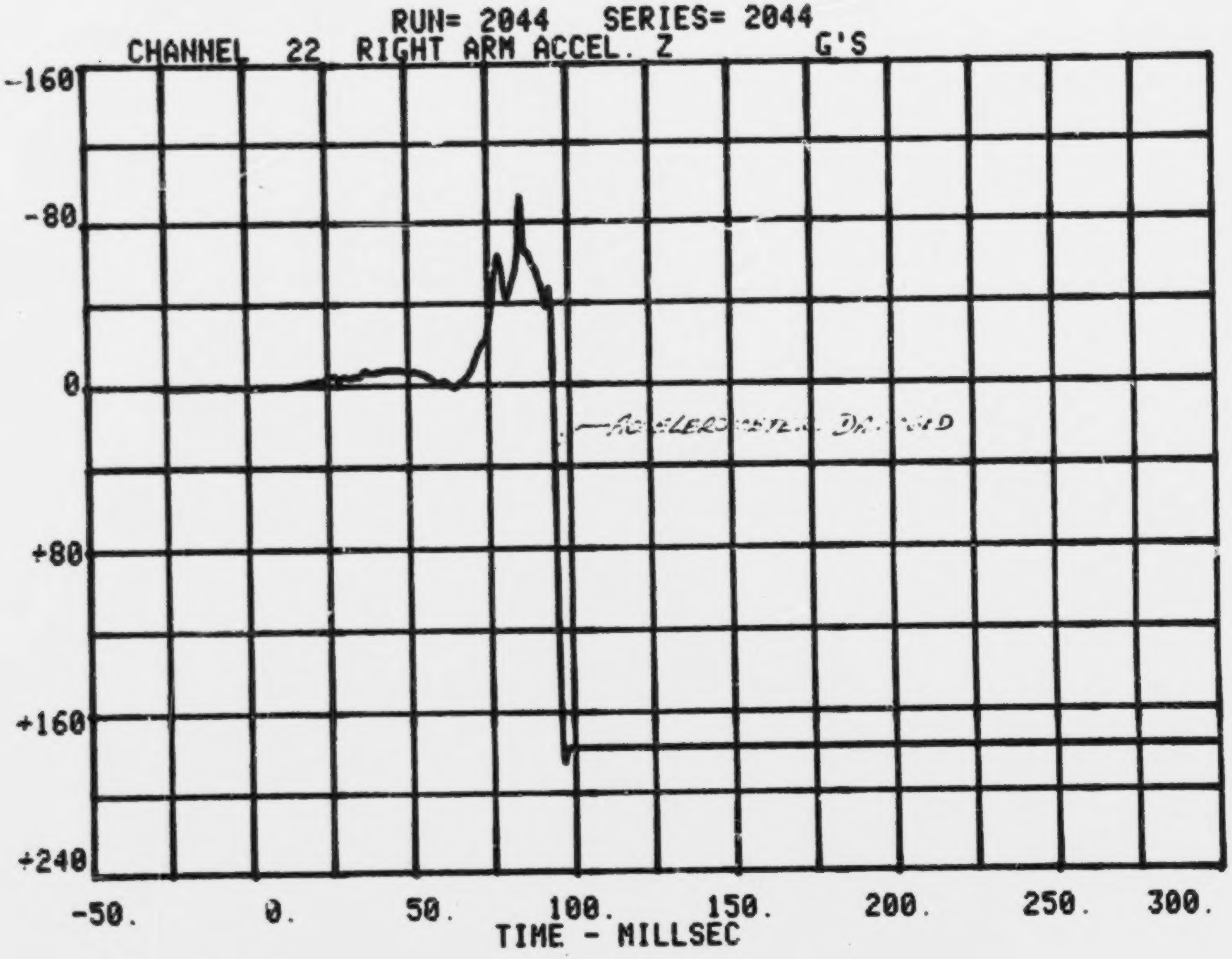

RUN= 2044 SERIES= 2044
CHANNEL 4 RESULT. LEFT ARM ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

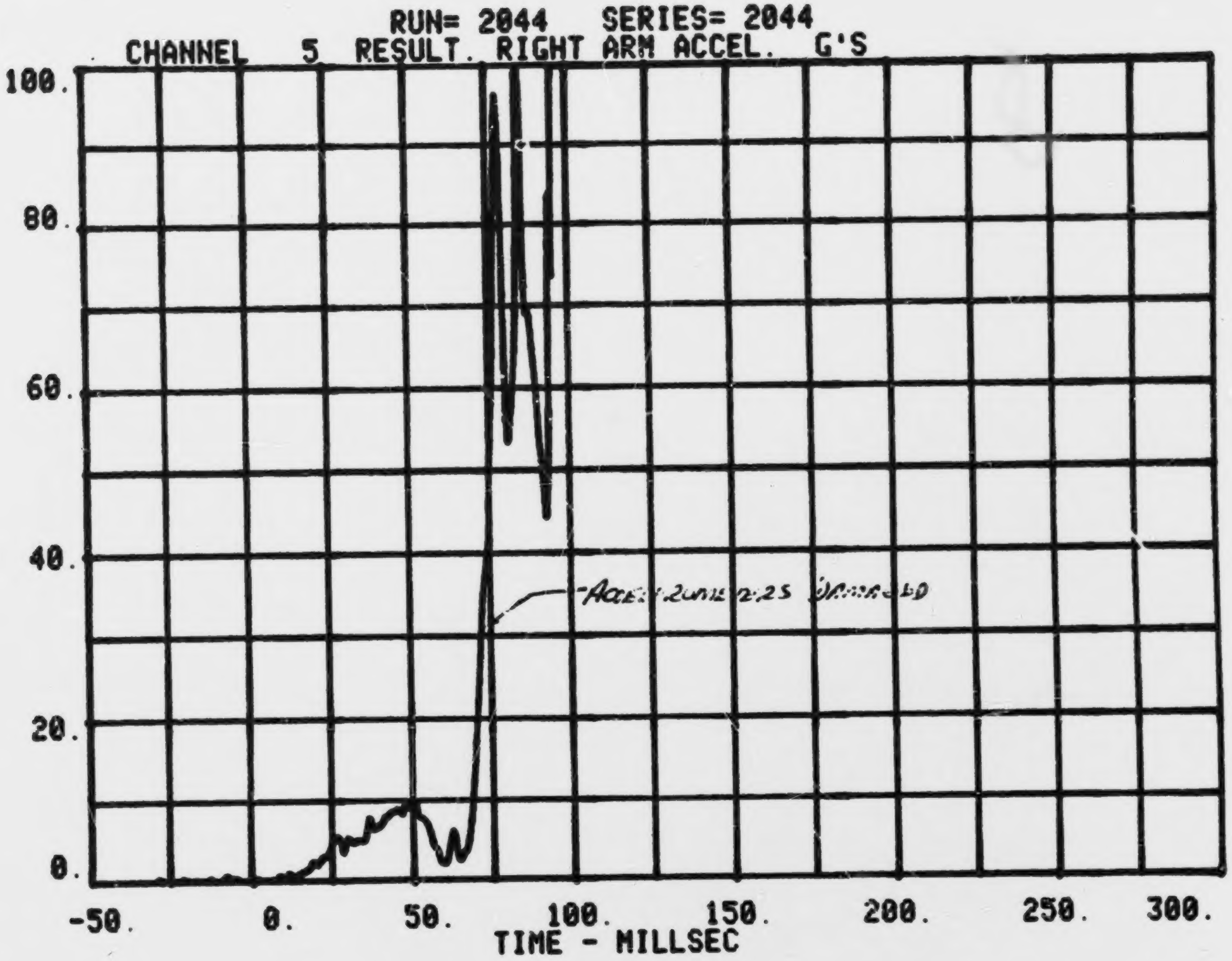

RUN= 2044 SERIES= 2044
CHANNEL 20 RIGHT ARM ACCEL. X G'S
320
240
160
80
0
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC
Accelerometer Damaged

RUN= 2044 SERIES= 2044

CHANNEL 21 RIGHT ARM ACCEL. Y G'S

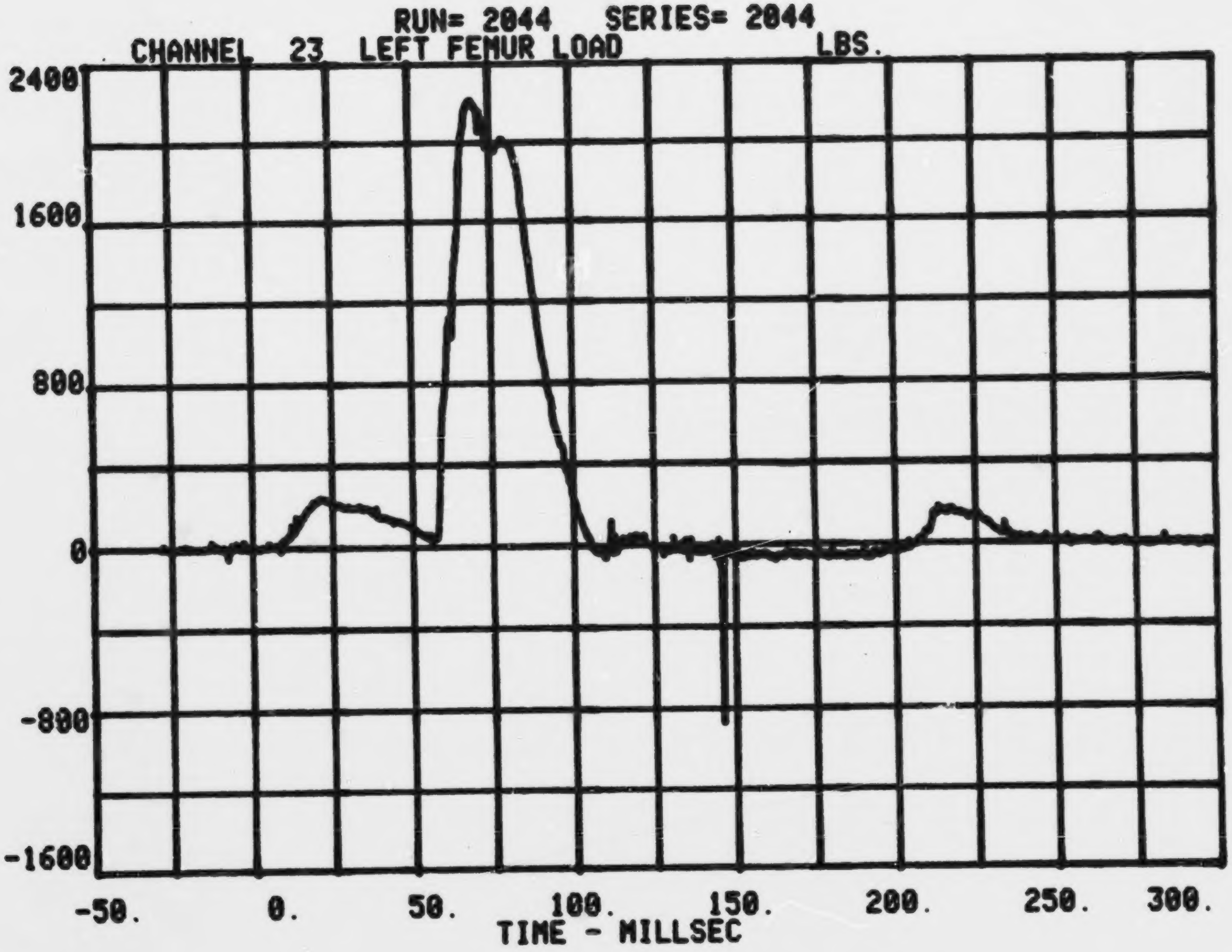



RUN= 2044 SERIES= 2044
CHANNEL 22 RIGHT ARM ACCEL. Z G'S
-160
-80
0
+80
+160
+240
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC
— ACCELEROMETER DROPPED

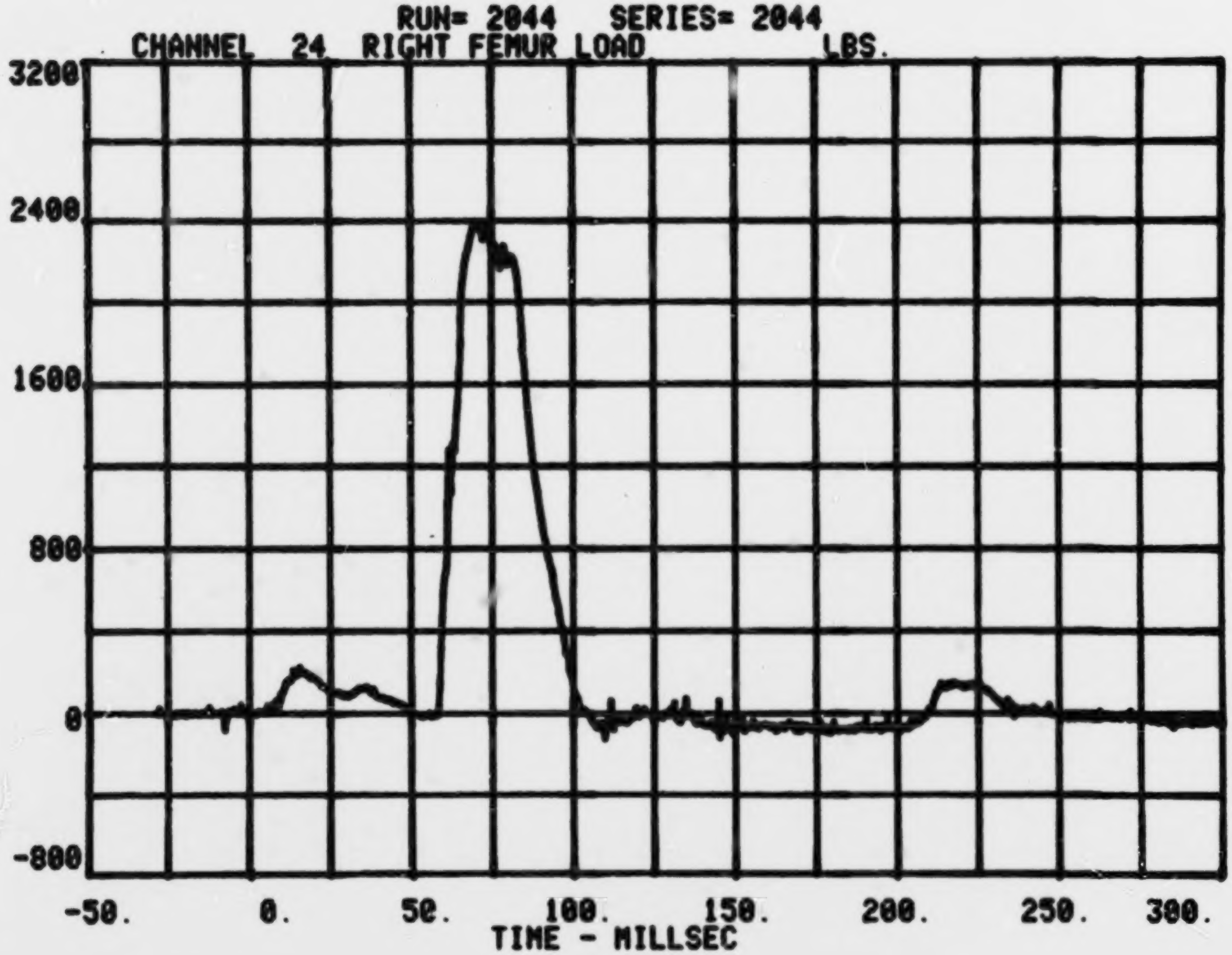


RUN= 2044 SERIES= 2044

CHANNEL 5 RESULT. RIGHT ARM ACCEL. G'S

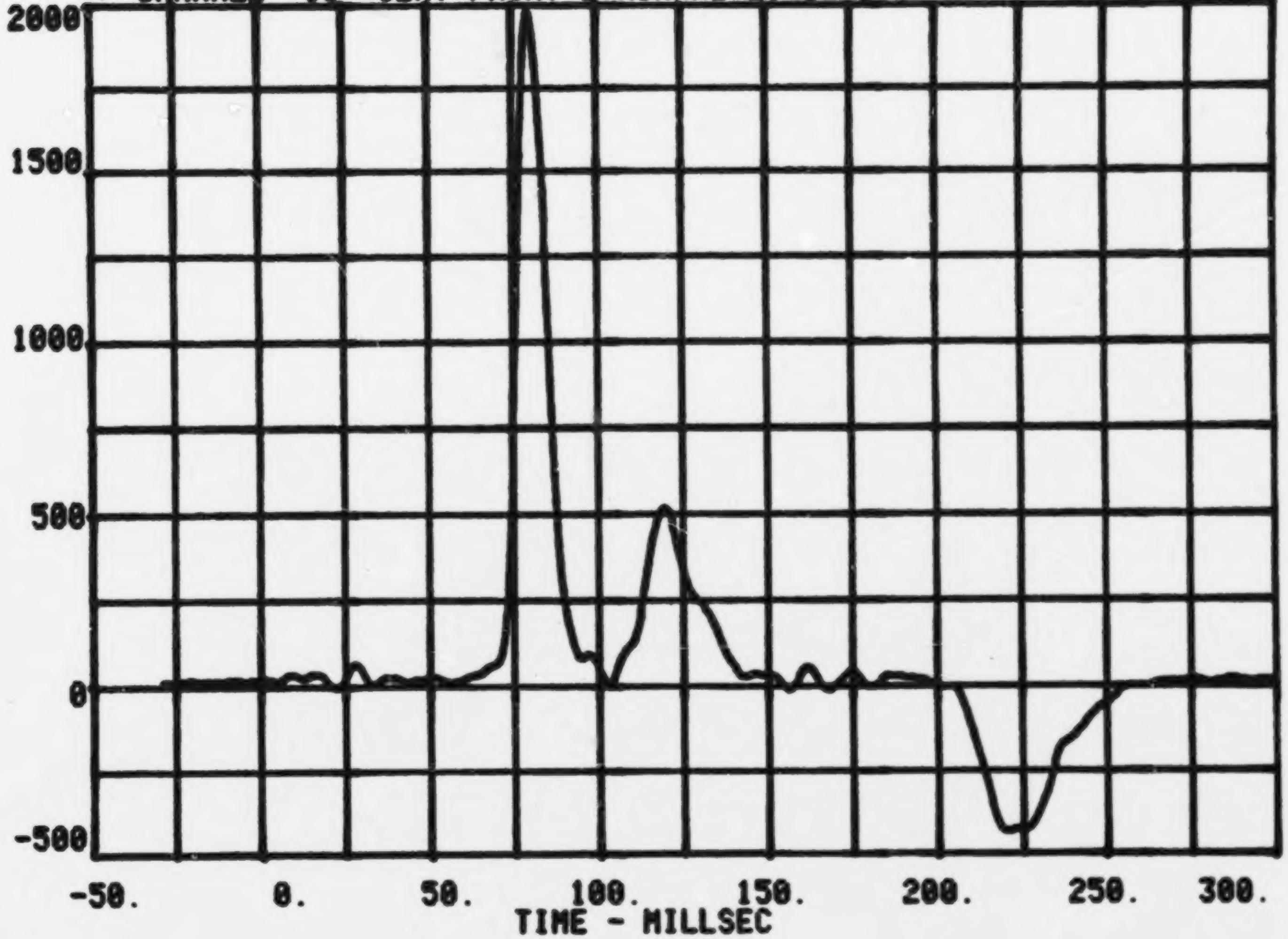


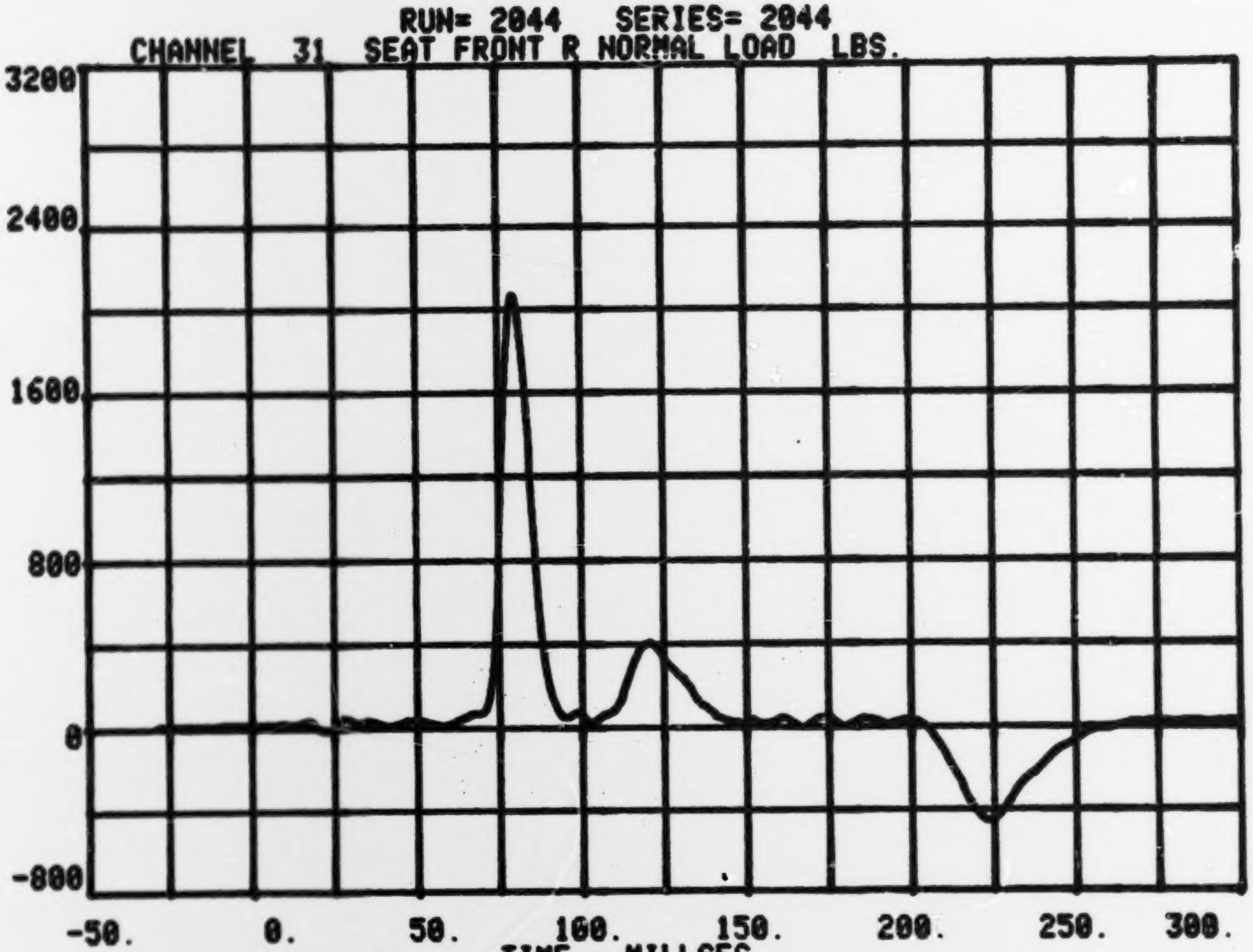
BEST DOCUMENT AVAILABLE

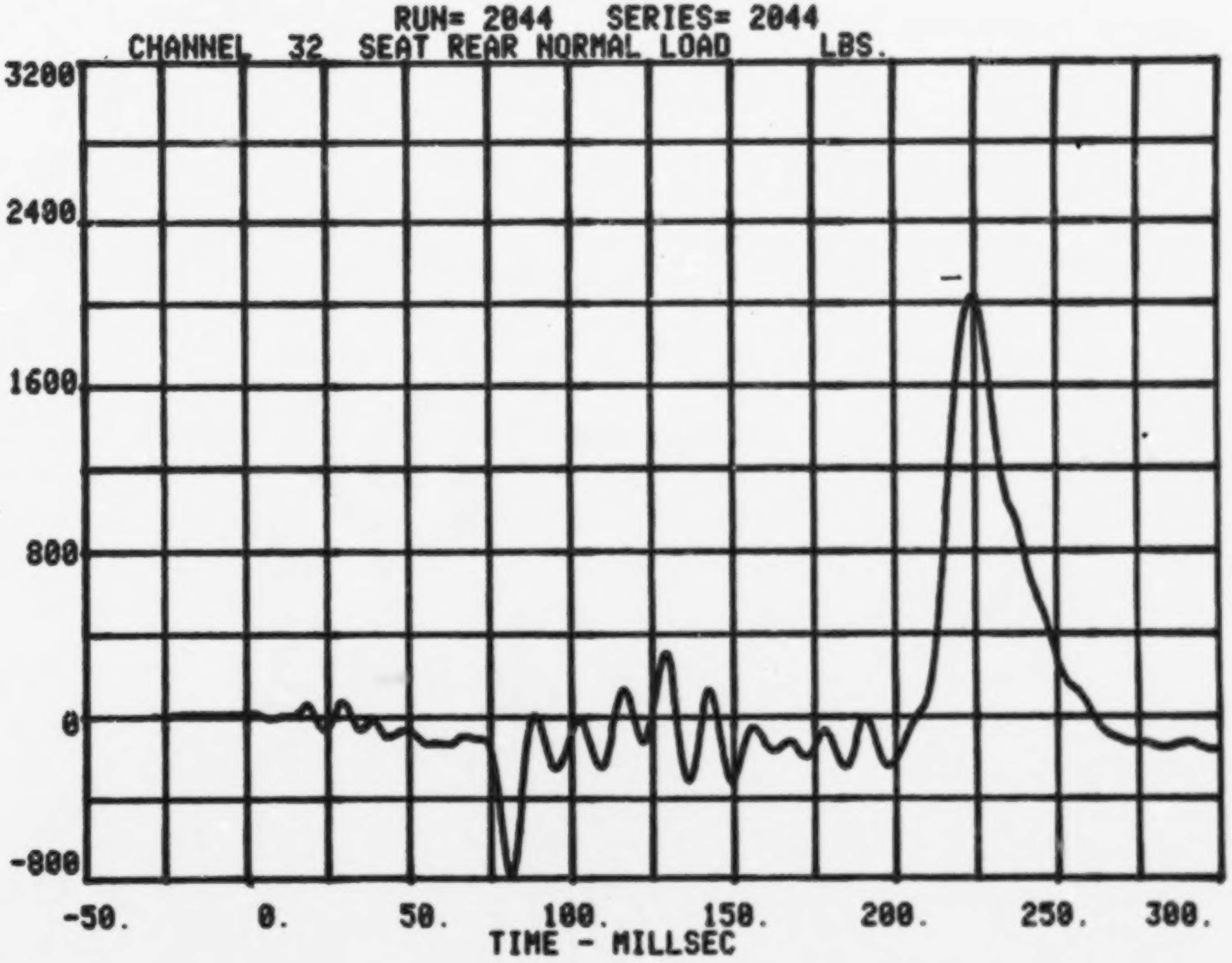


BEST DOCUMENT AVAILABLE

RUN= 2044 SERIES= 2044
CHANNEL 30 SEAT FRONT L NORMAL LOAD LBS.

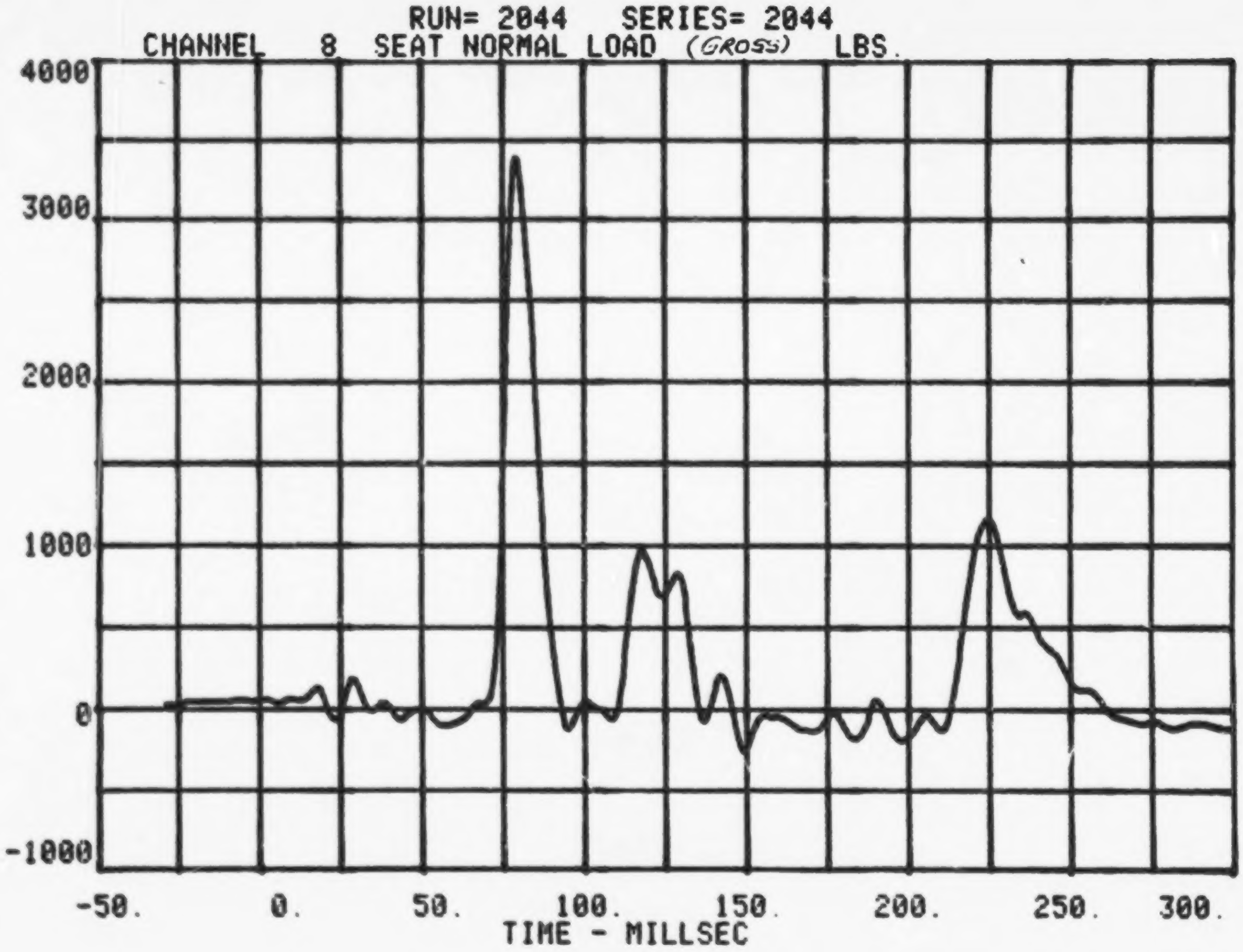


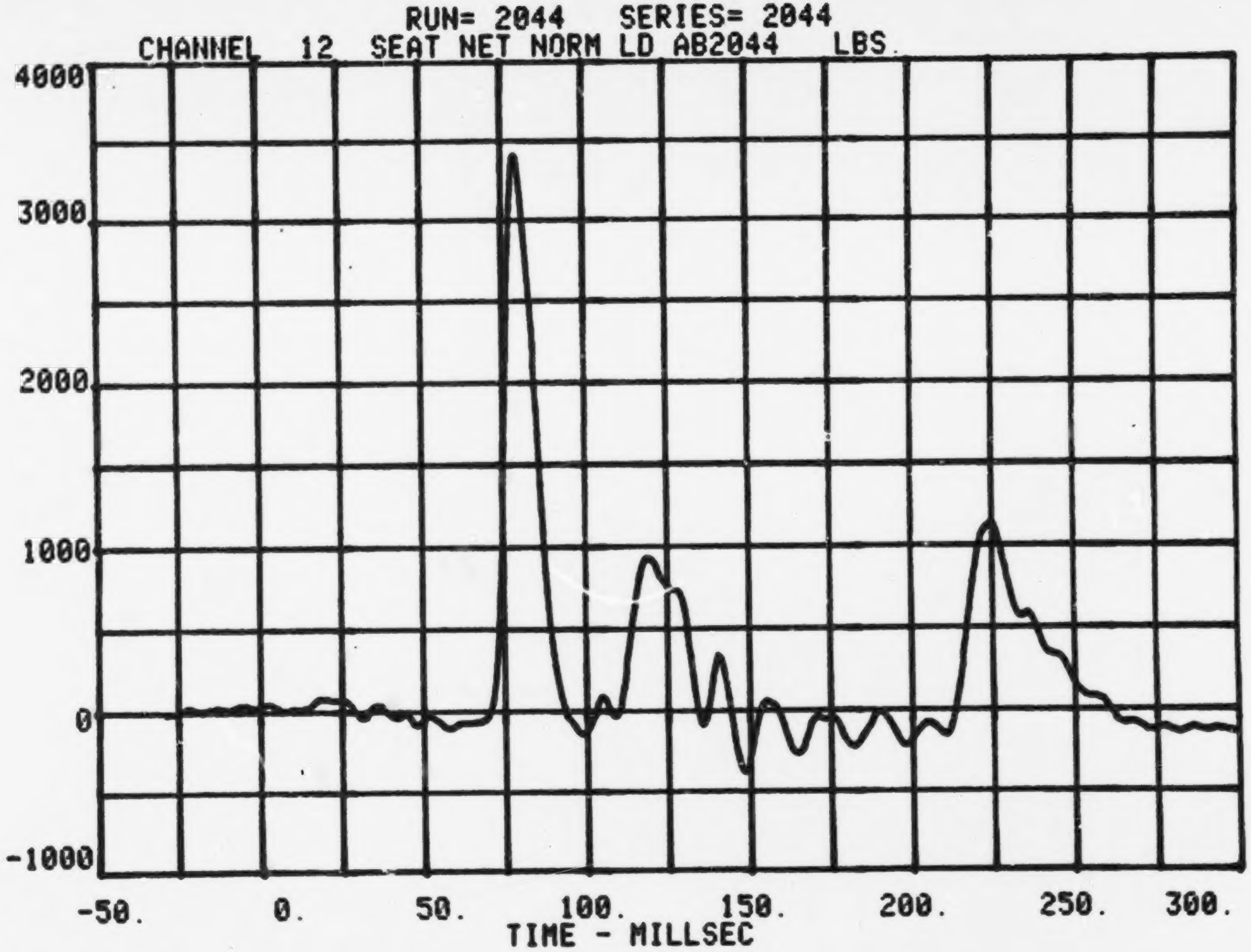

RUN= 2044 SERIES= 2044
CHANNEL 31 SEAT FRONT R NORMAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



RUN= 2044 SERIES= 2044

CHANNEL 32 SEAT REAR NORMAL LOAD LBS.

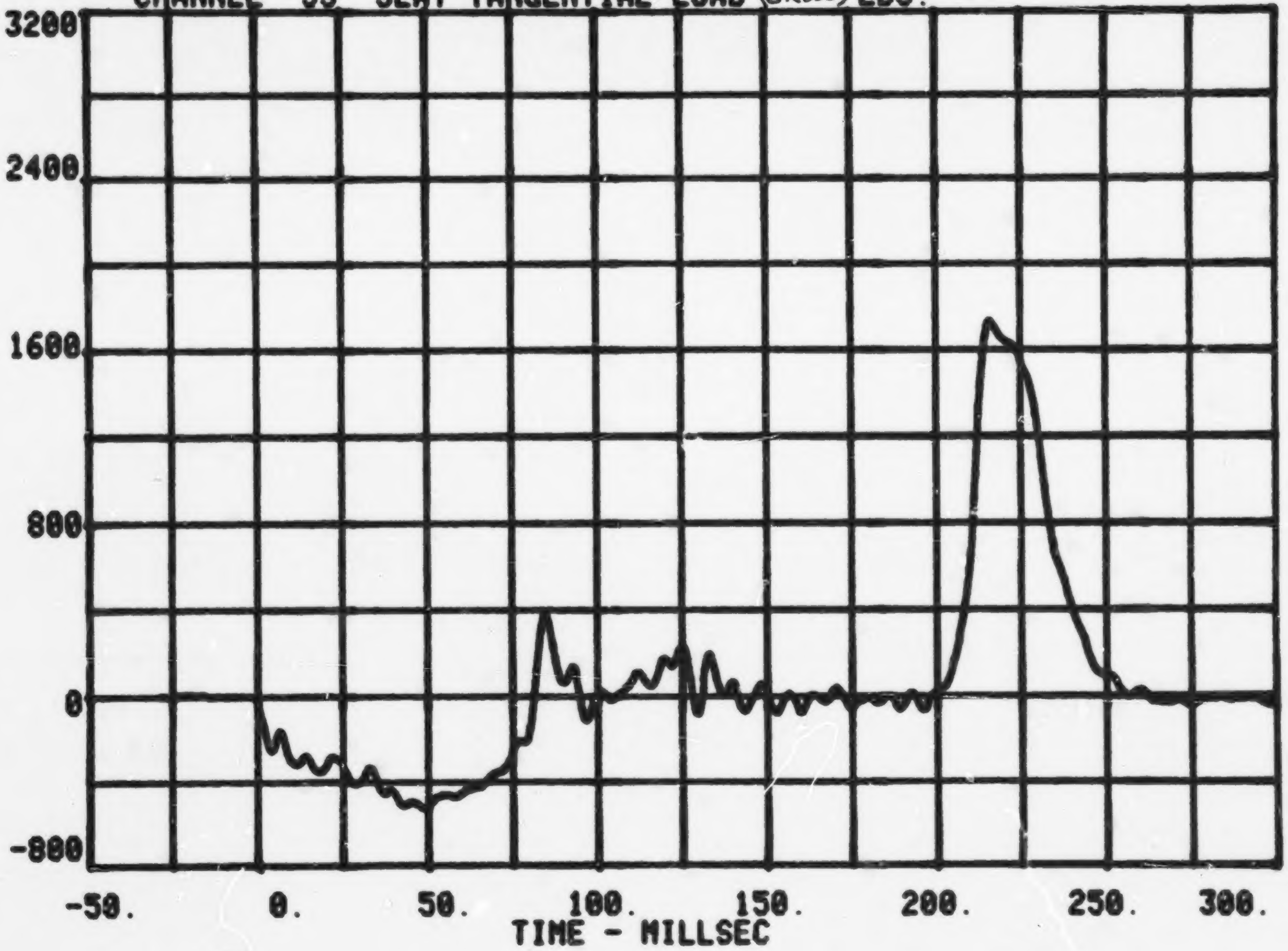

RUN= 2044 SERIES= 2044
CHANNEL 8 SEAT NORMAL LOAD (GROSS) LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



BEST DOCUMENT AVAILABLE

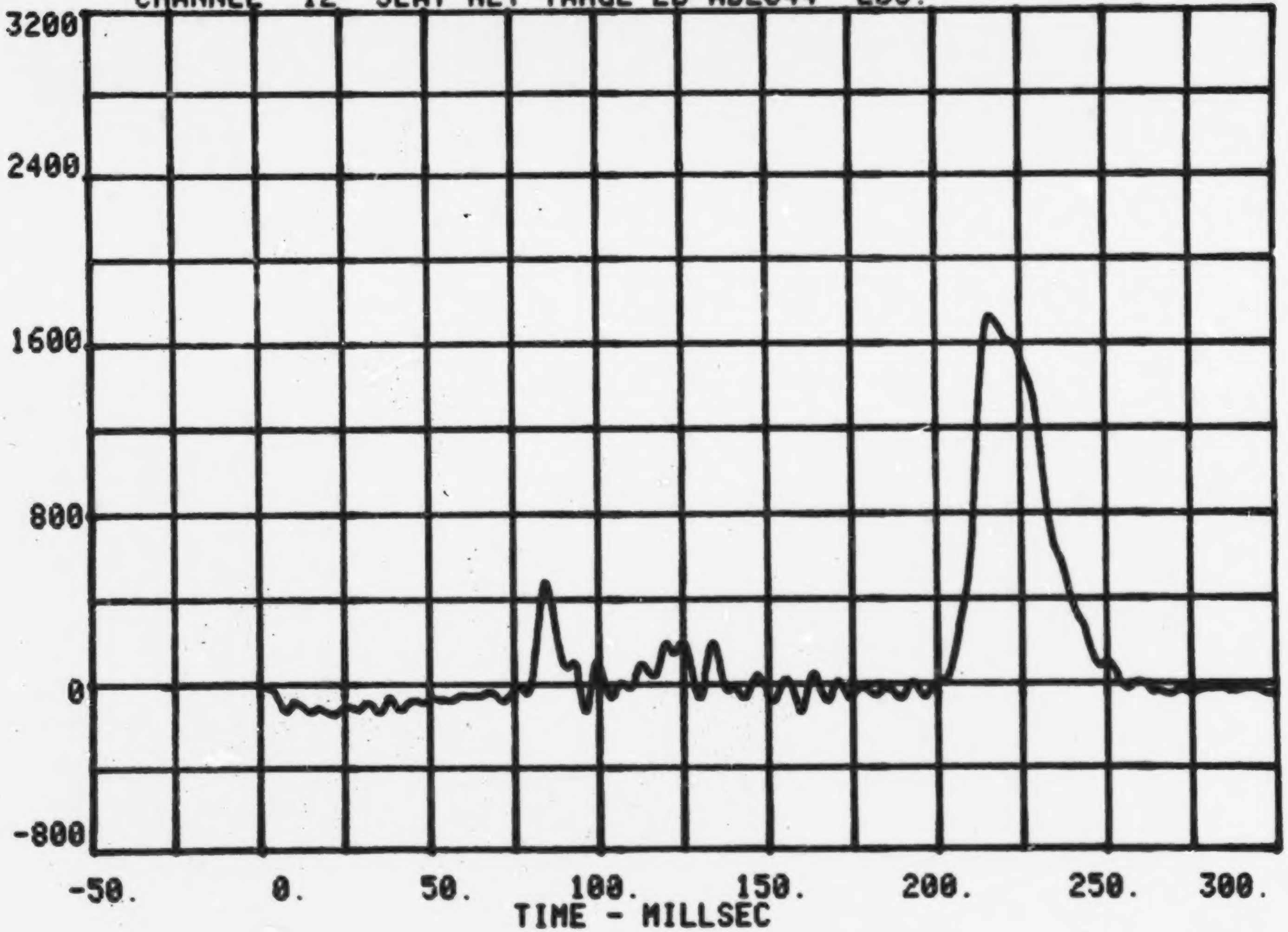
RUN= 2044 SERIES= 2044

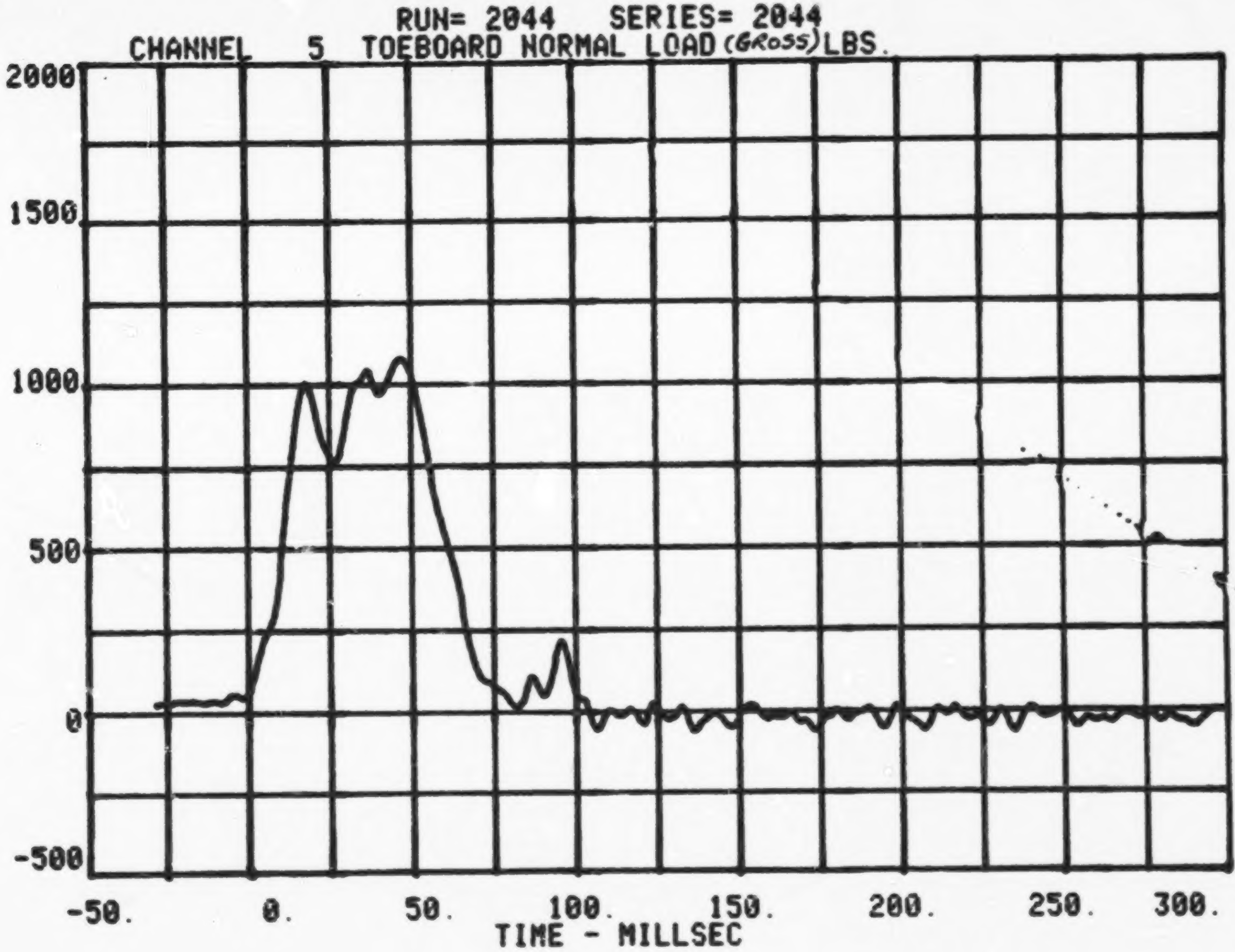
CHANNEL 33 SEAT TANGENTIAL LOAD (GROSS) LBS.

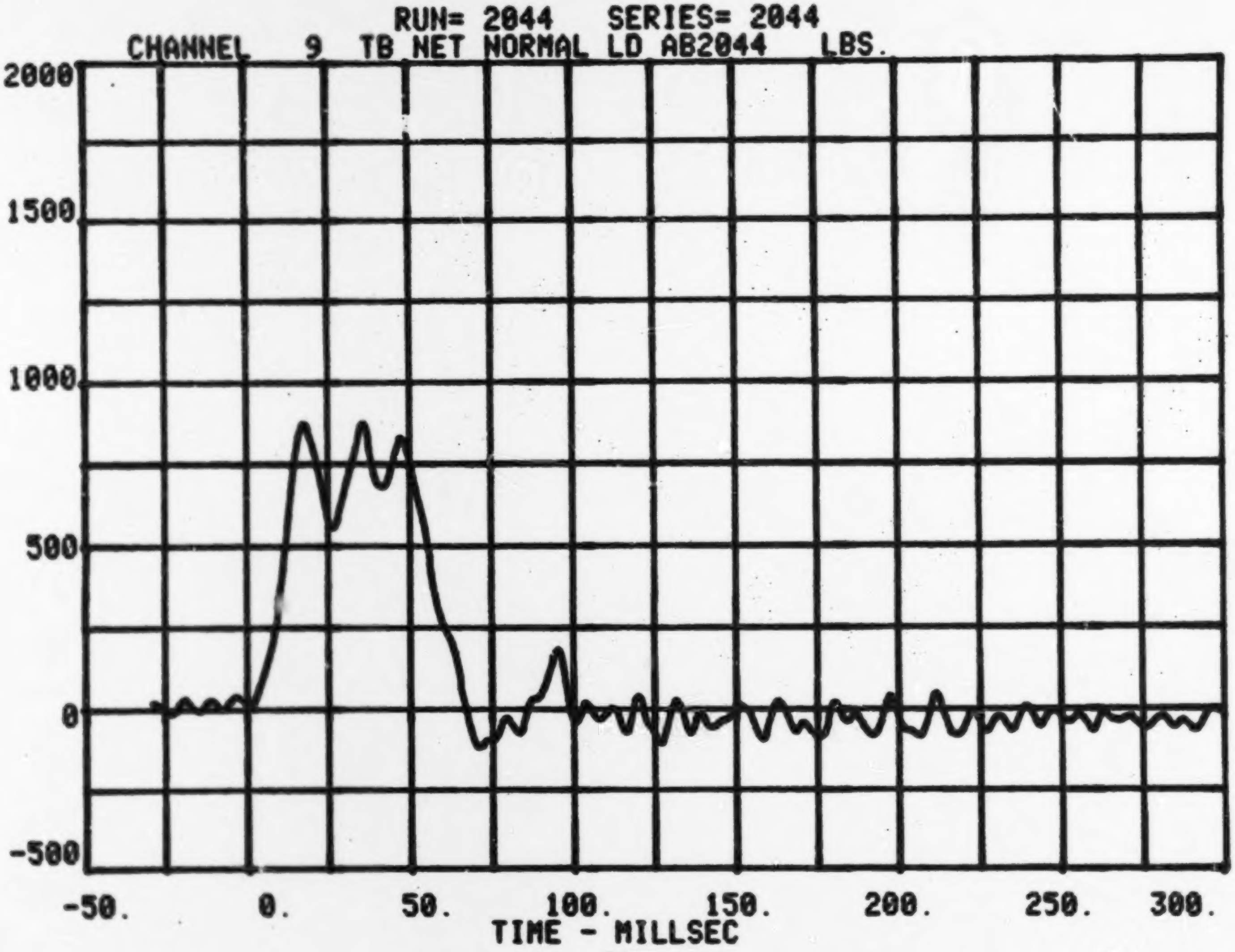


BEST DOCUMENT AVAILABLE

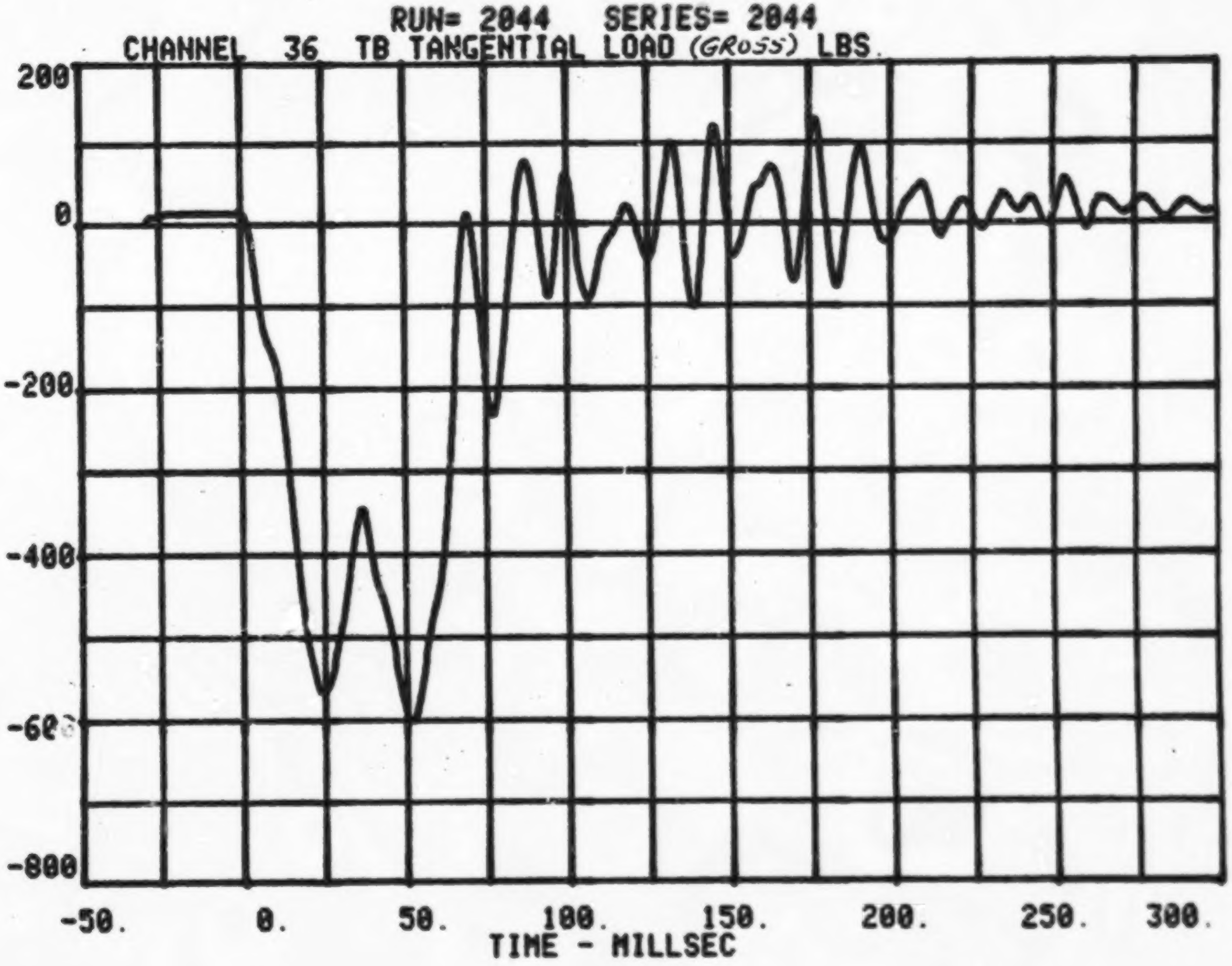
RUN= 2044 SERIES= 2044
CHANNEL 12 SEAT NET TANGL LD AB2044 LBS.

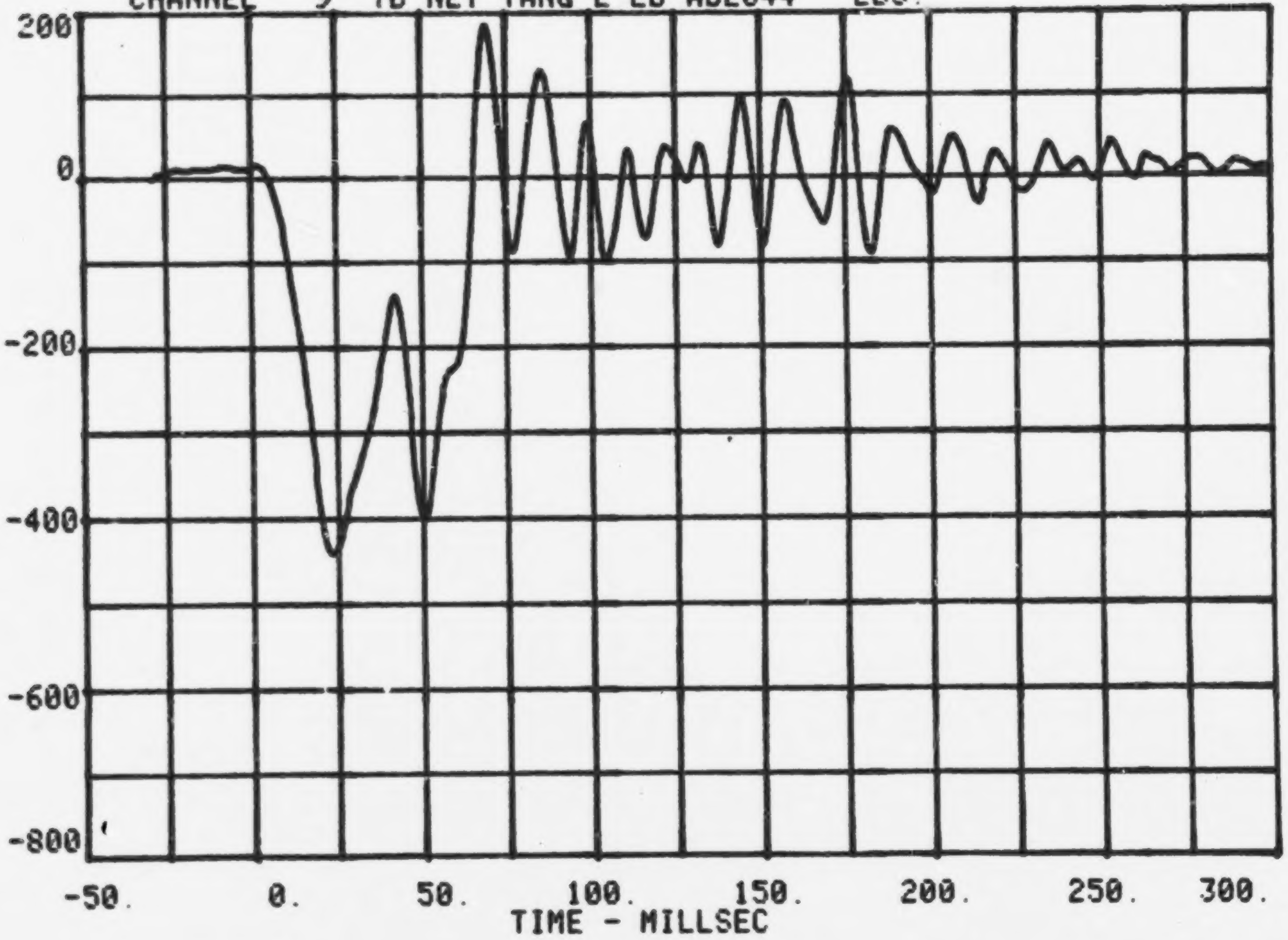



RUN= 2044 SERIES= 2044
CHANNEL 5 TOEBOARD NORMAL LOAD (GROSS) LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



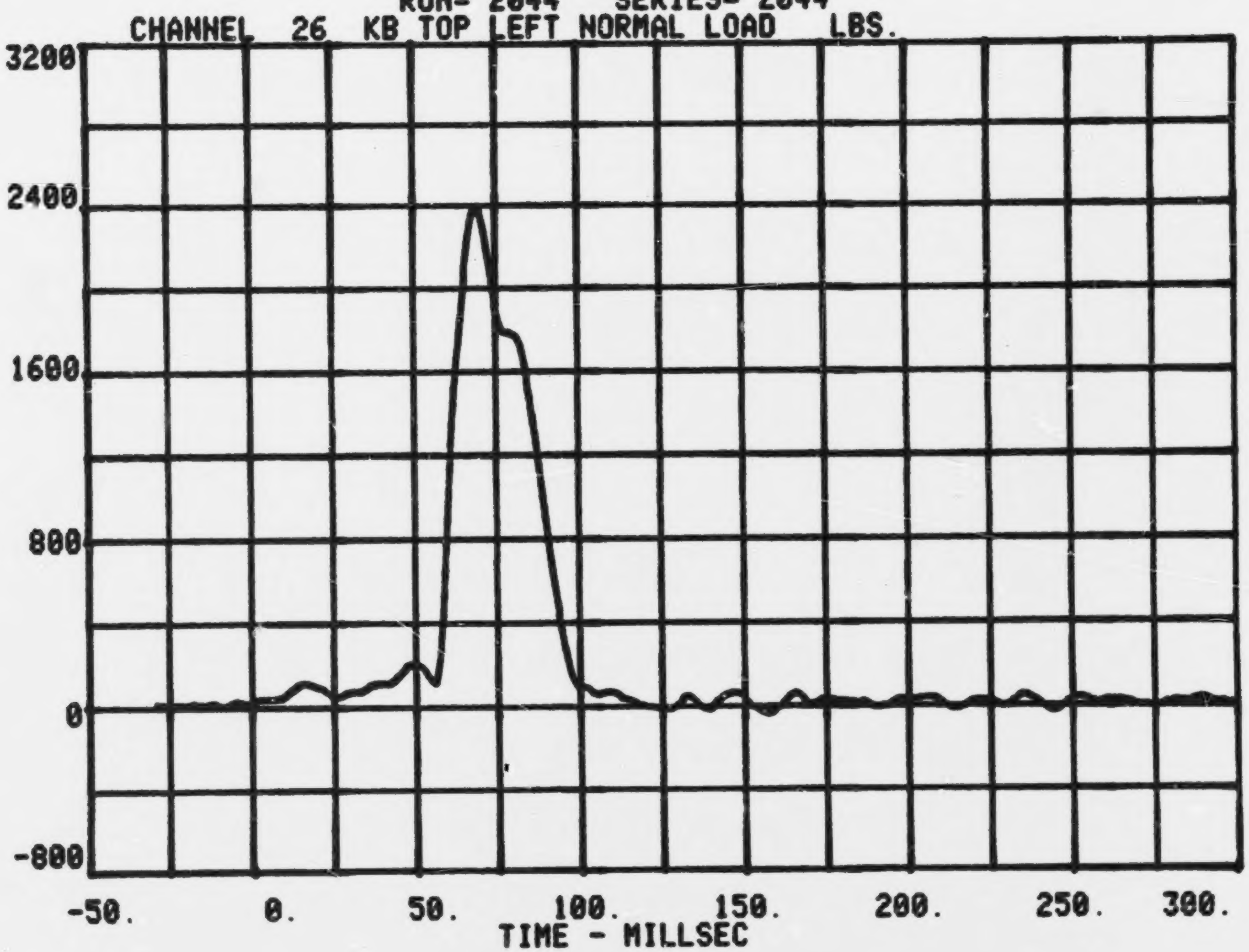
BEST DOCUMENT AVAILABLE

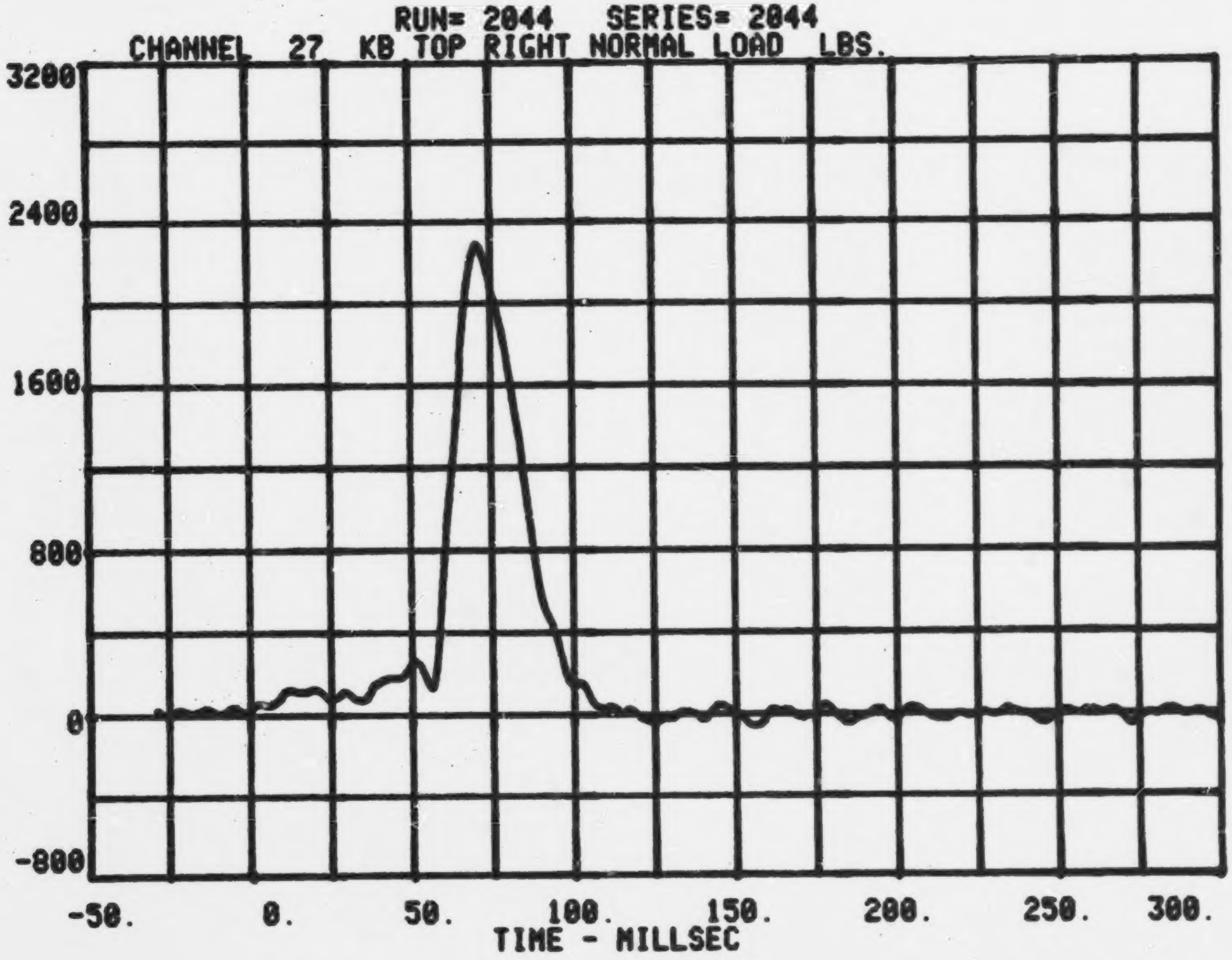

RUN= 2044 SERIES= 2044
CHANNEL 36 TB TANGENTIAL LOAD (GROSS) LBS.
200
0
-200
-400
-600
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



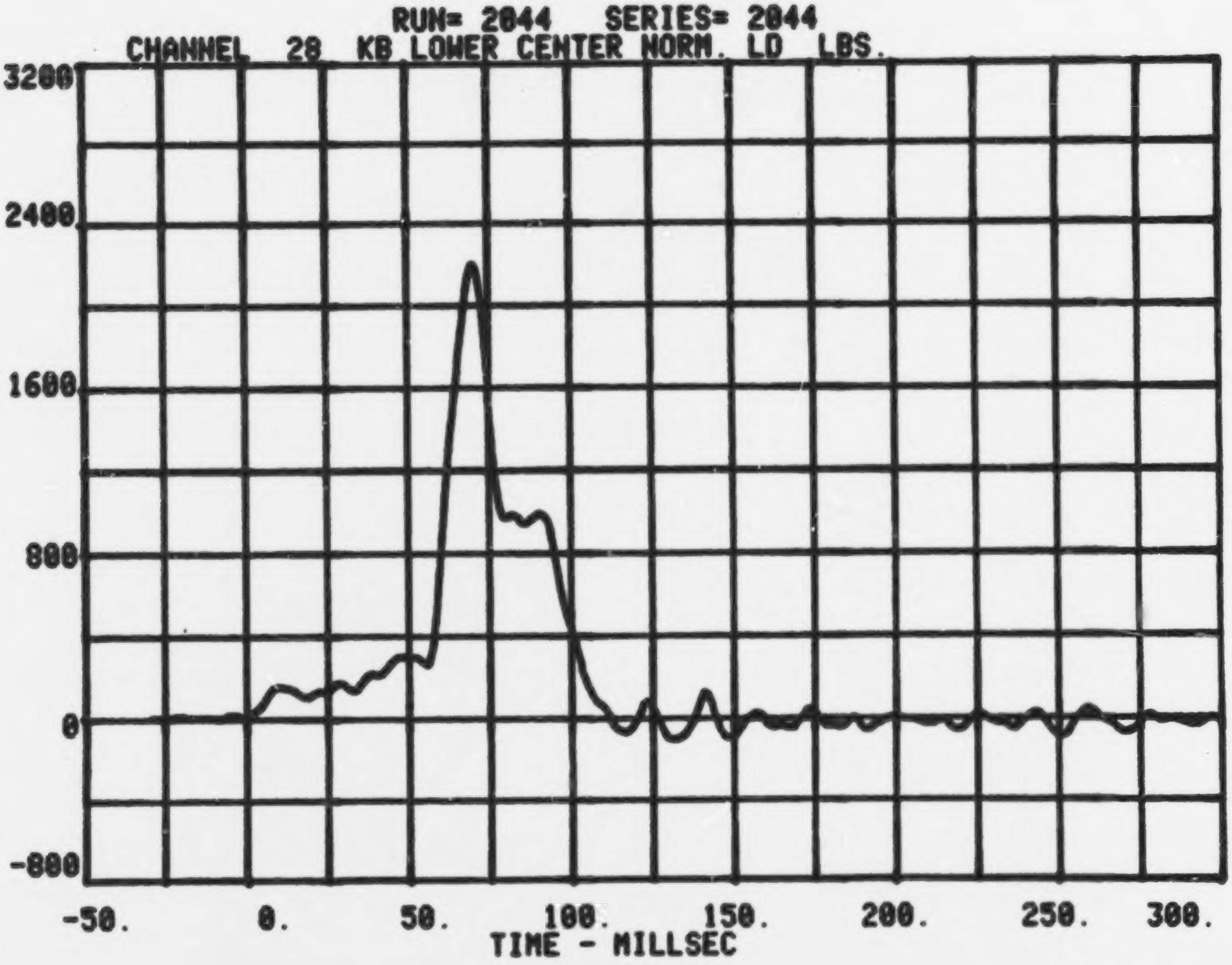
RUN= 2044 SERIES= 2044

CHANNEL 9 TB NET TANG'L LD AB2044 LBS.


RUN= 2044 SERIES= 2044
CHANNEL 26 KB TOP LEFT NORMAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

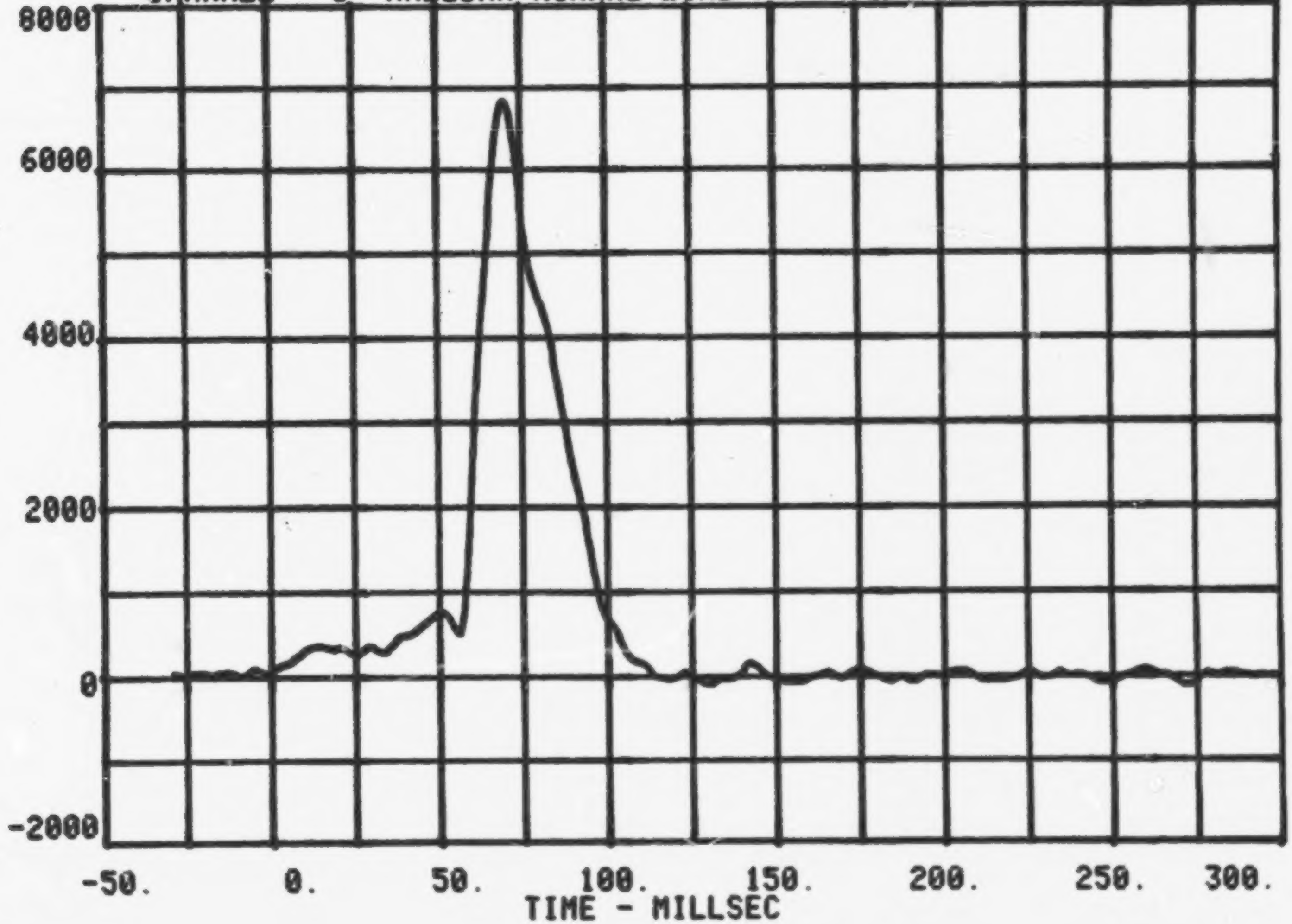


BEST DOCUMENT AVAILABLE

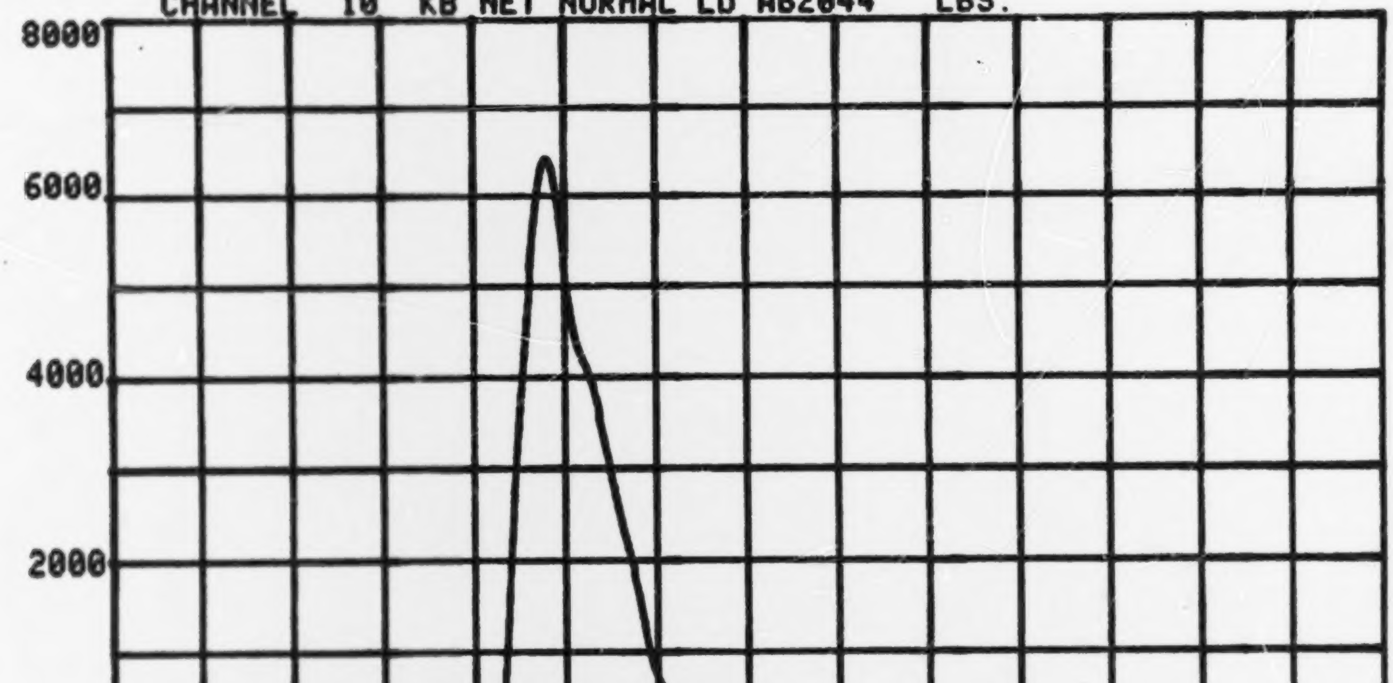


RUN= 2044 SERIES= 2044
CHANNEL 28 KB LOWER CENTER NORM. LD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

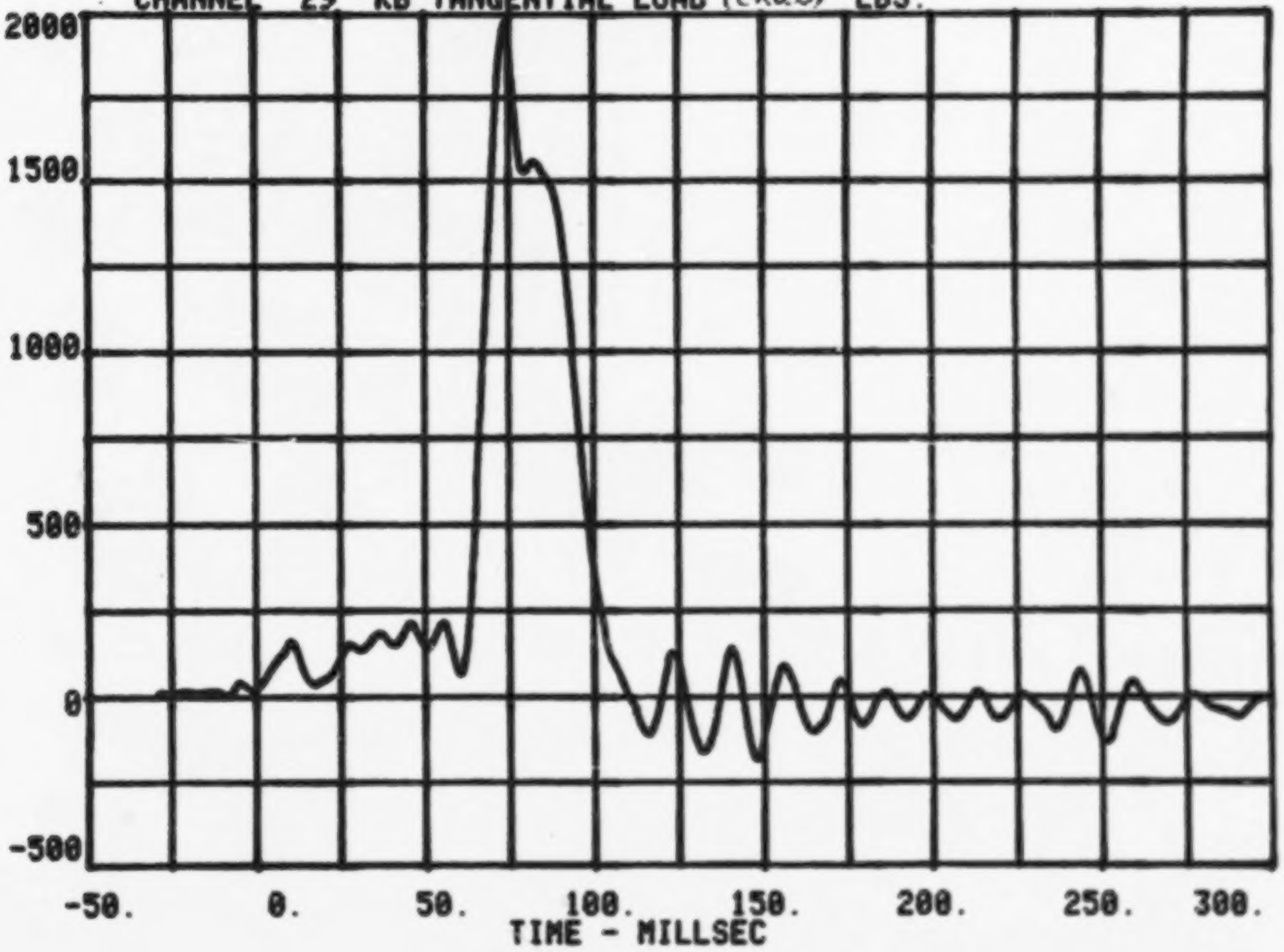
RUN= 2044 SERIES= 2044
CHANNEL 6 KNEEBAR NORMAL LOAD (GROSS) LBS.



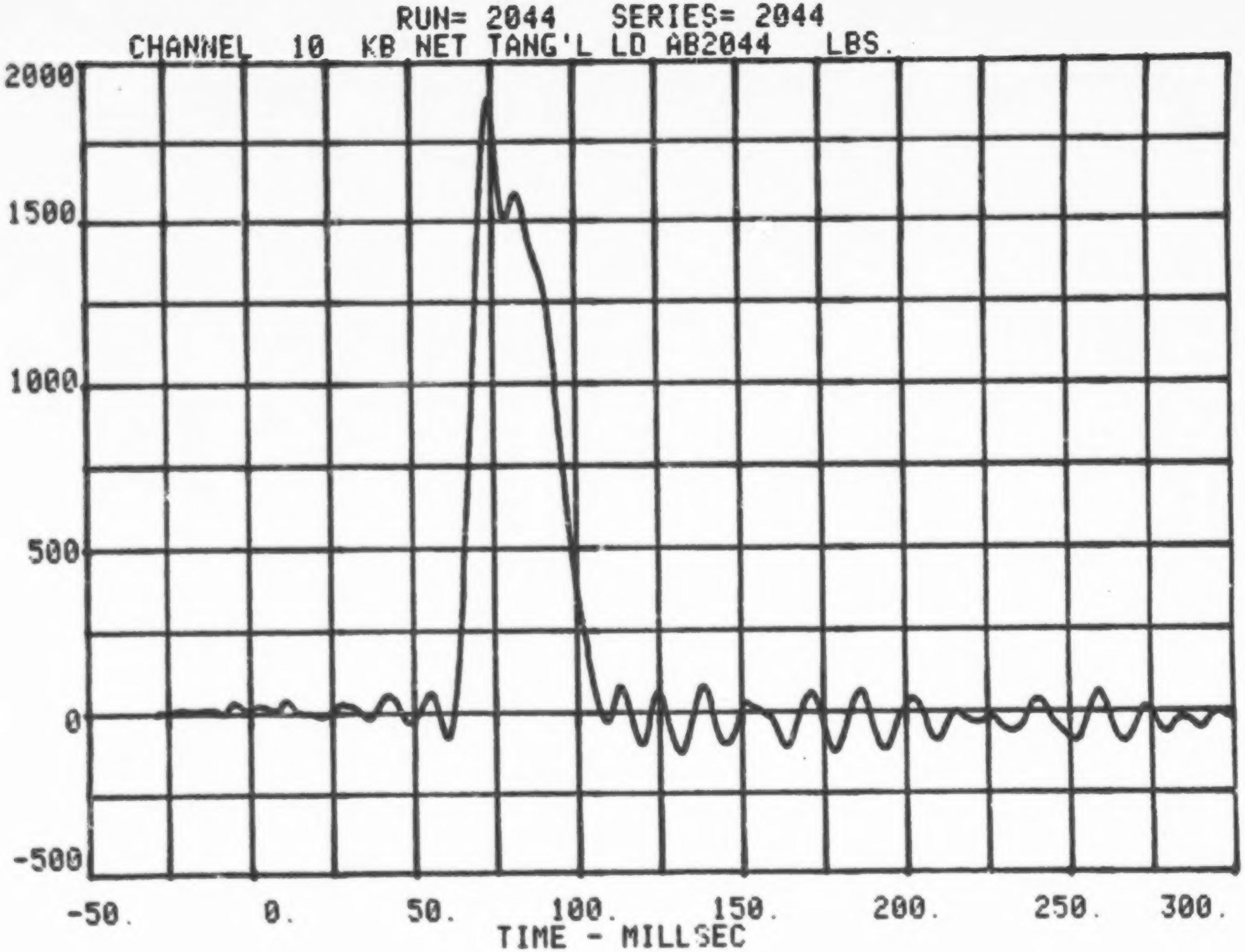
RUN= 2044 SERIES= 2044
CHANNEL 10 KB NET NORMAL LD AB2044 LBS.



BEST DOCUMENT AVAILABLE

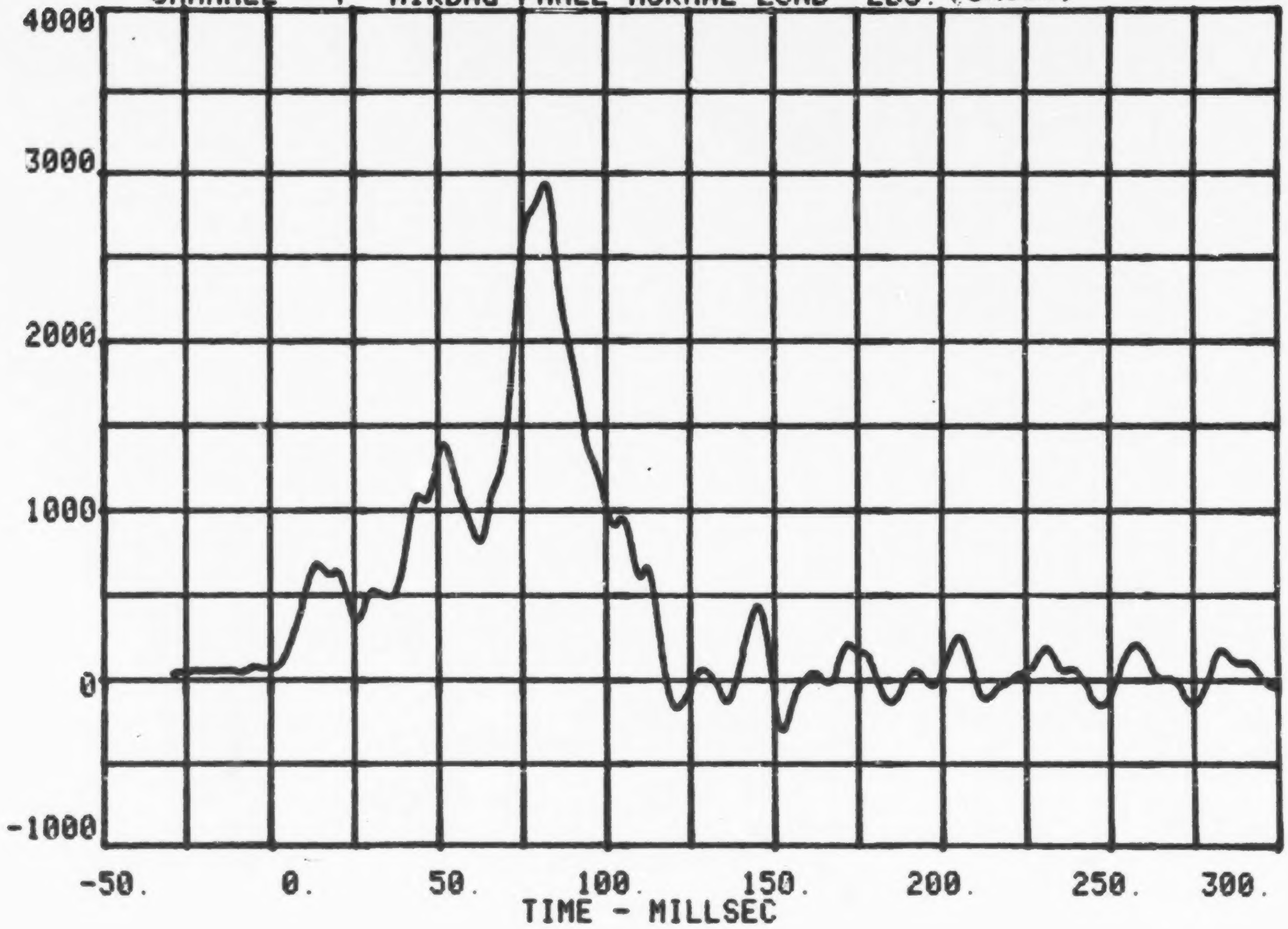


RUN= 2044 SERIES= 2044
CHANNEL 29 KB TANGENTIAL LOAD (CROSS) LBS.


RUN= 2044 SERIES= 2044
CHANNEL 10 KB NET TANG'L LD AB2044 LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

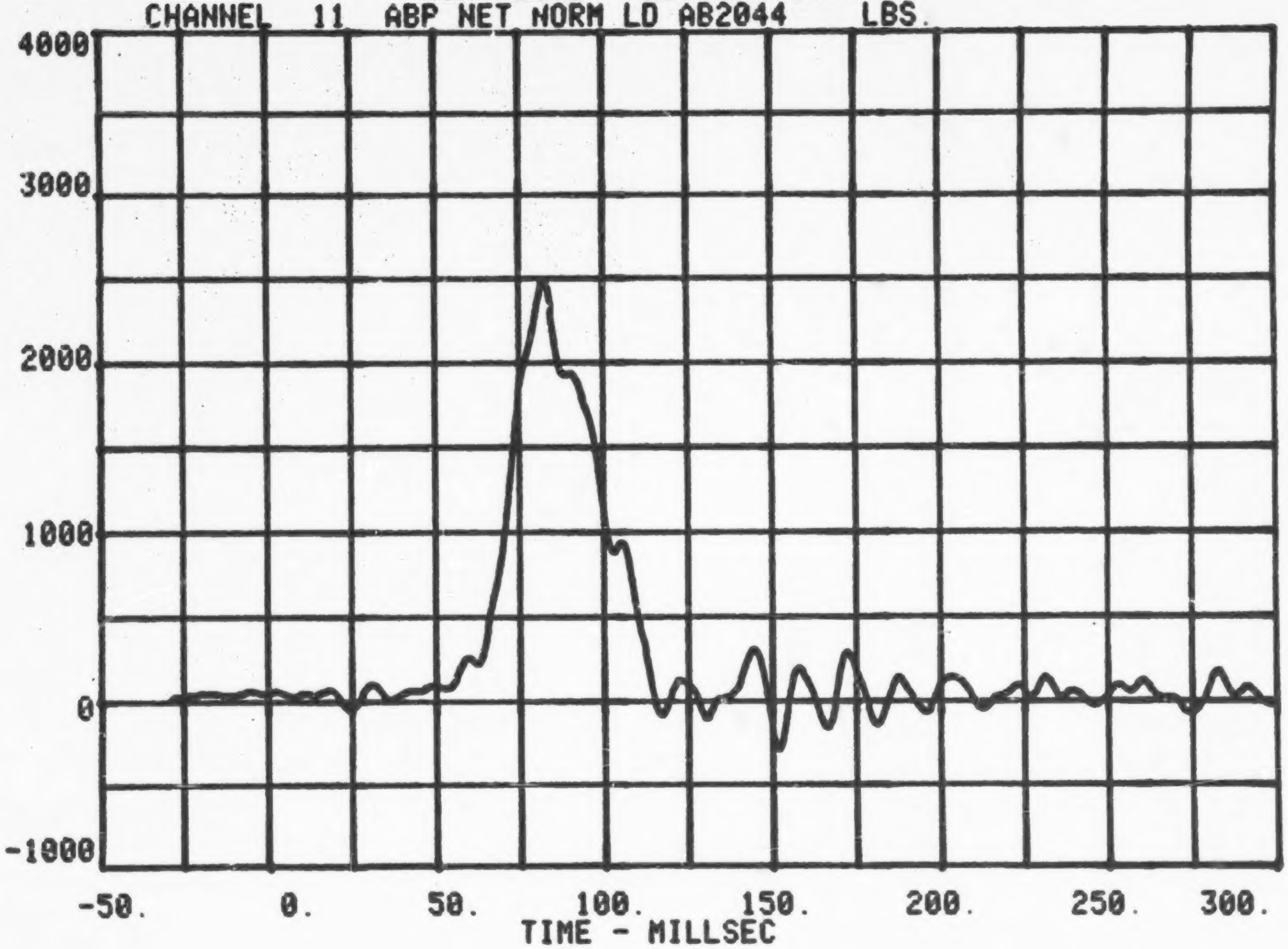
RUN= 2044 SERIES= 2044

CHANNEL 7 AIRBAG PANEL NORMAL LOAD LBS. (GROSS)



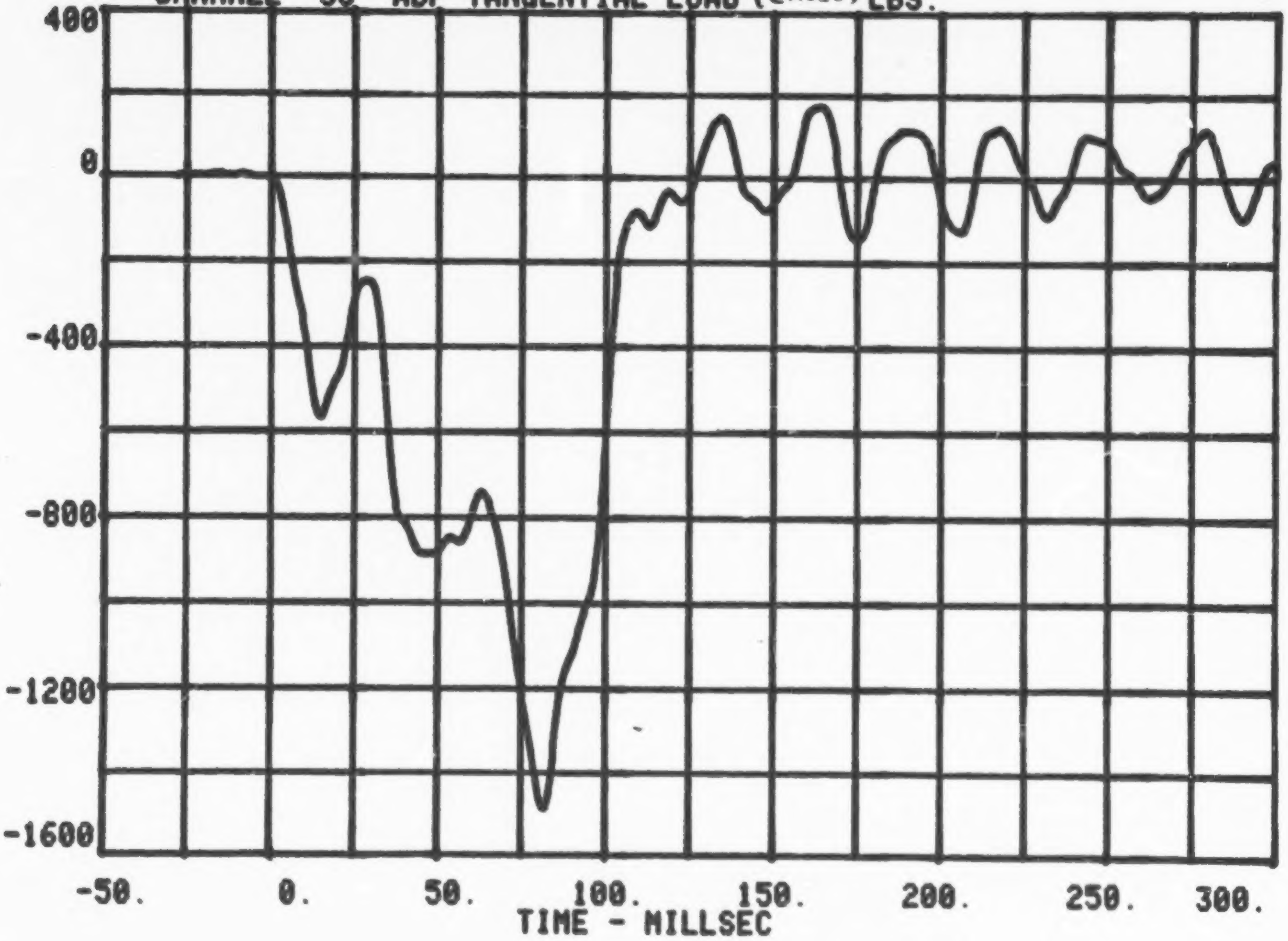
BEST DOCUMENT AVAILABLE

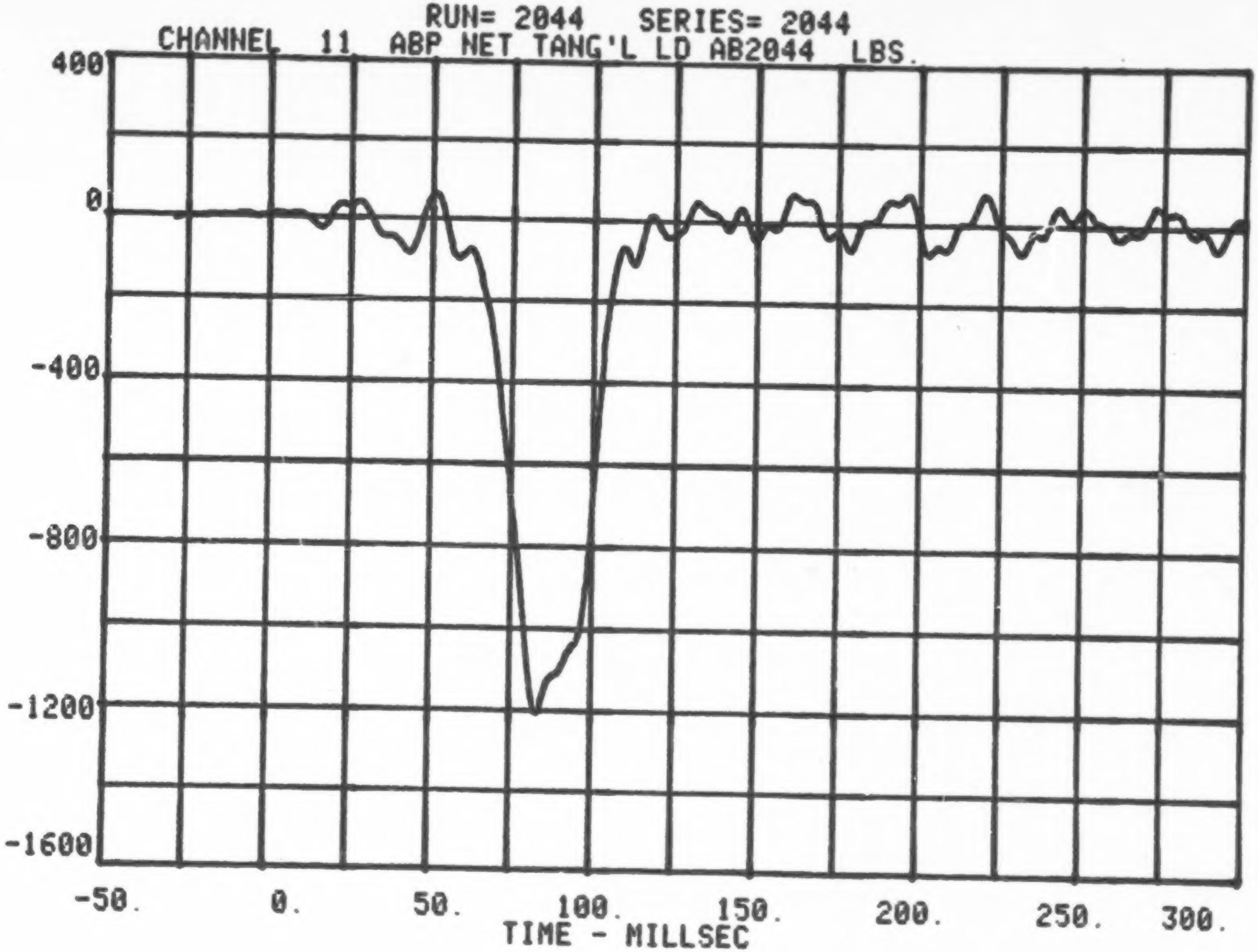
RUN= 2044 SERIES= 2044
CHANNEL 11 ABP NET NORM LD AB2044 LBS.

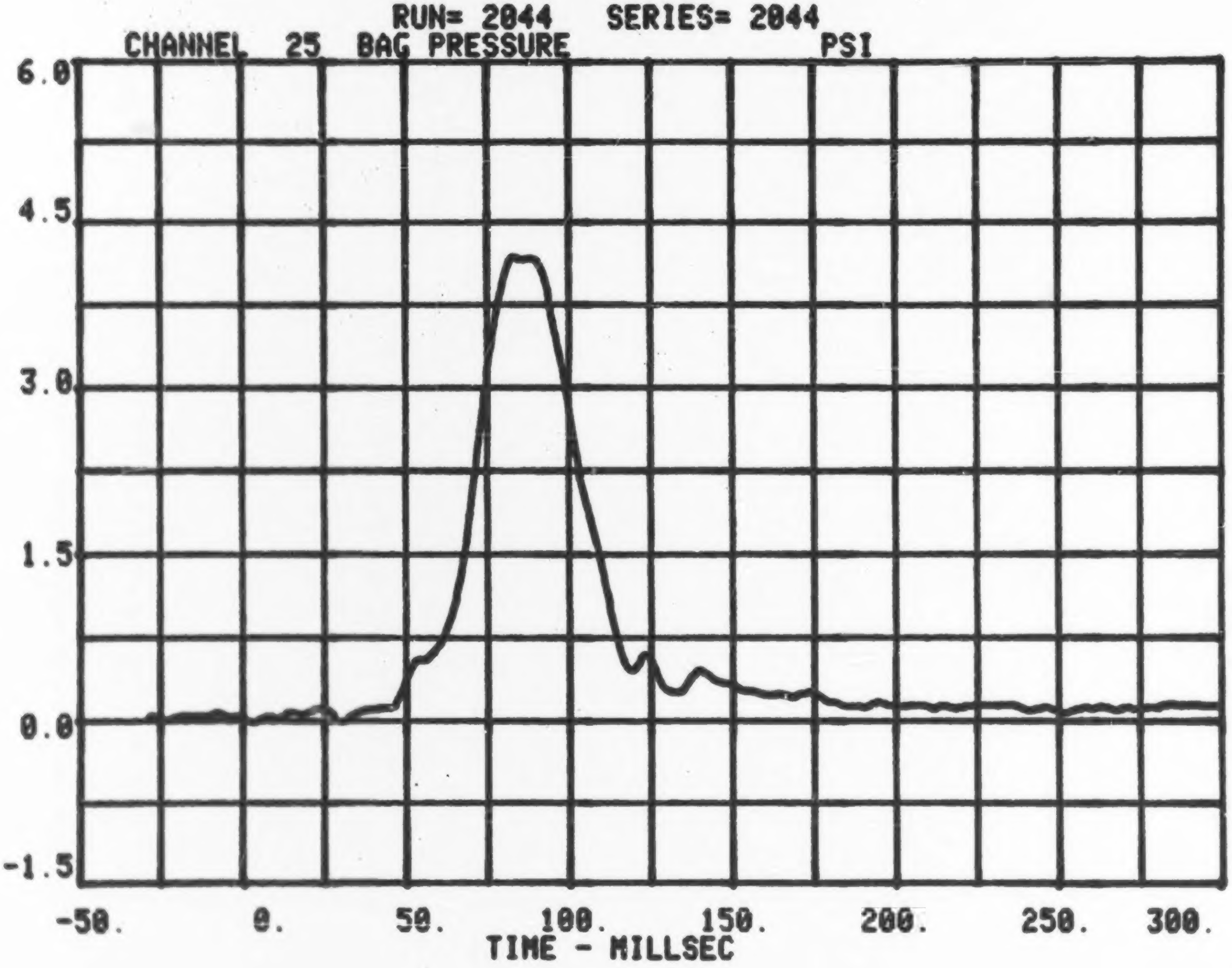


BEST DOCUMENT AVAILABLE

RUN= 2044 SERIES= 2044
CHANNEL 38 ABP TANGENTIAL LOAD (GAUGE) LBS.

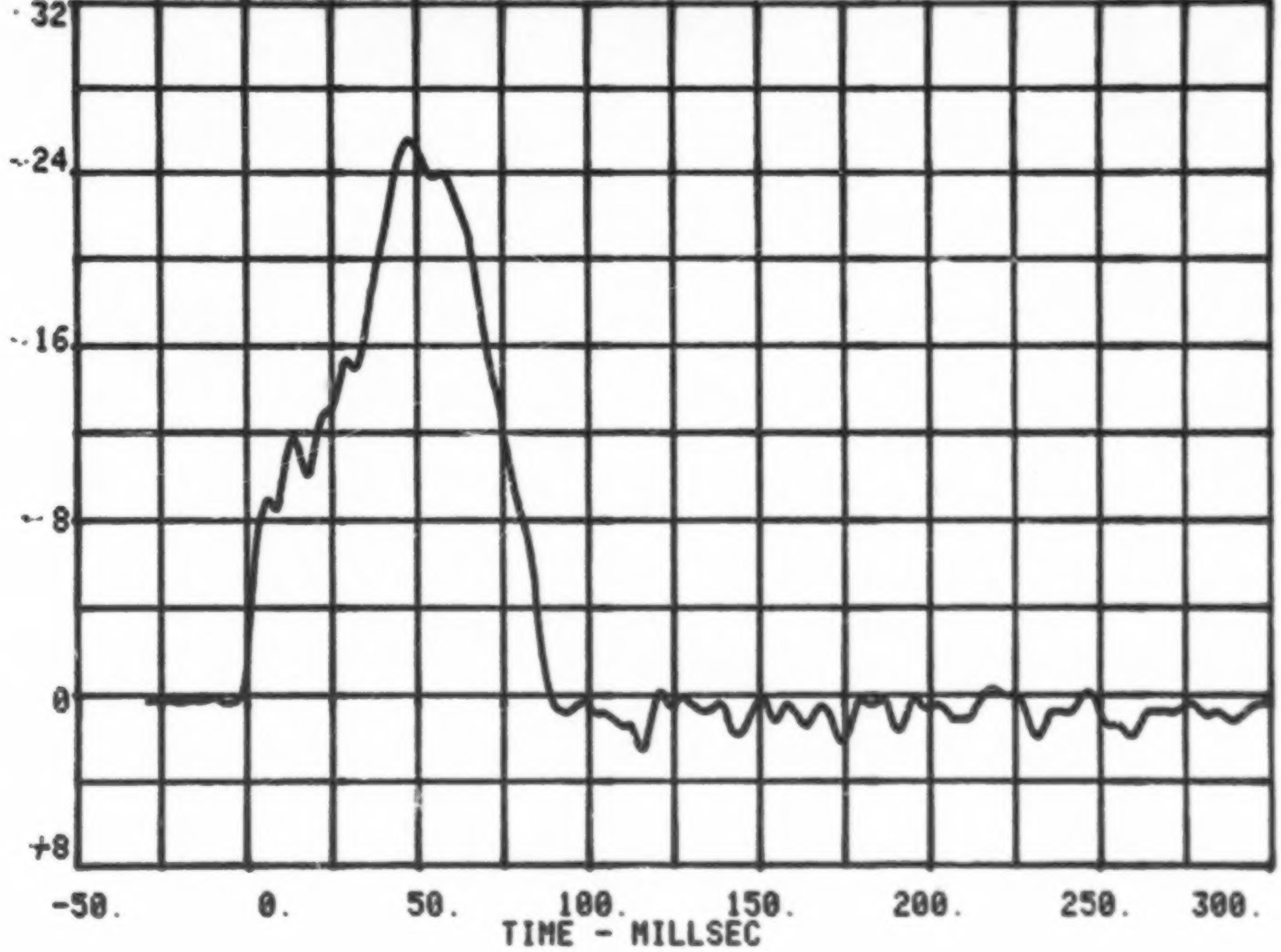



RUN= 2044 SERIES= 2044
CHANNEL 11 ABP NET TANG'L LD AB2044 LBS.
400
0
-400
-800
-1200
-1600
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



BEST DOCUMENT AVAILABLE

RUN= 2044 SERIES= 2044
CHANNEL 8 SLED ACCEL. PULSE X G'S



BEST DOCUMENT AVAILABLE

APPENDIX D

AIR BAG RESTRAINT SLED TEST 2045 DATA RECORDS

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Pelvis Accelerations	180
Femur Loads	600
Contact Panel Loads	60
Bag Pressure	60
Sled Acceleration	60

Sequence of Data Records

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Pelvis - X, Y, Z, Resultant Accelerations

Femur Load - Left, Right

Seat Normal Load - Front Left, Front Right, Rear, Gross Sum, Net Sum

Seat Tangential Load - Gross, Net

Toeboard Normal Load - Lower Left, Lower Right, Upper Center, Gross Sum, Net Sum

Toeboard Tangential Load - Gross, Net

Knee Bolster Normal Load - Top Left, Top Right, Lower Center, Gross Sum, Net Sum

Knee Bolster Tangential Load - Gross, Net

Air Bag Panel Normal Load - Lower Left, Lower Right, Top, Gross Sum, Net Sum

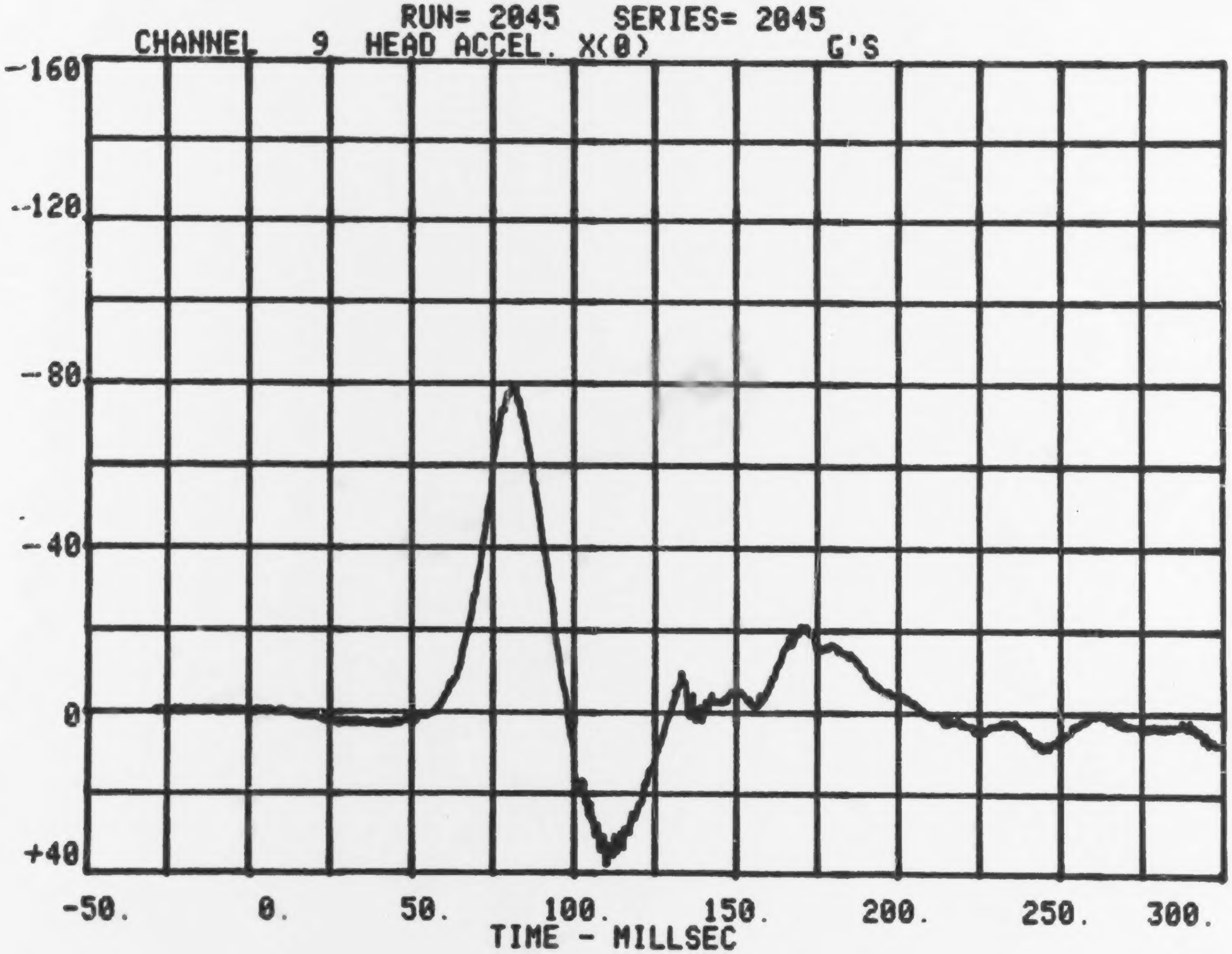
Air Bag Panel Tangential Load - Gross, Net

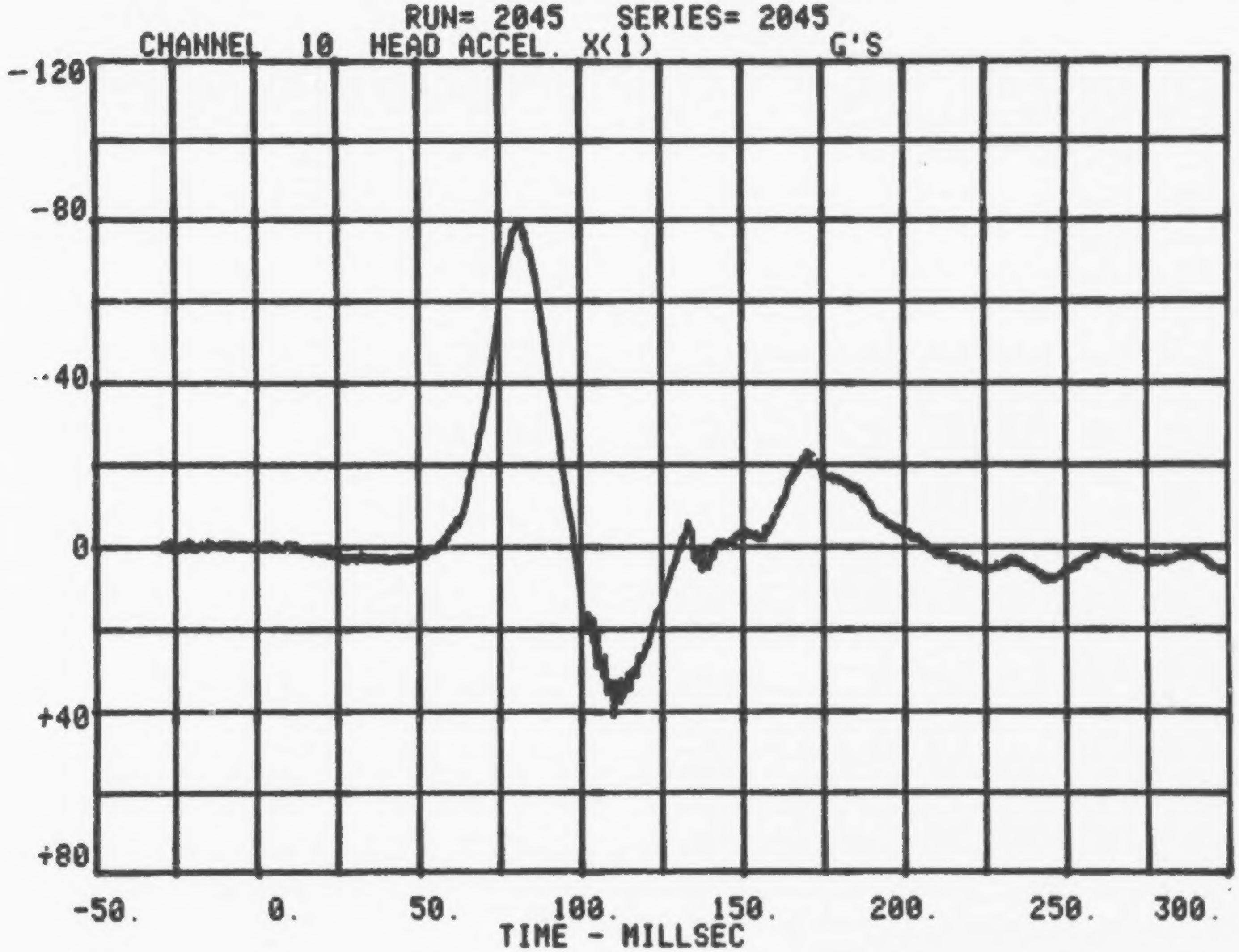
Air Bag Pressure

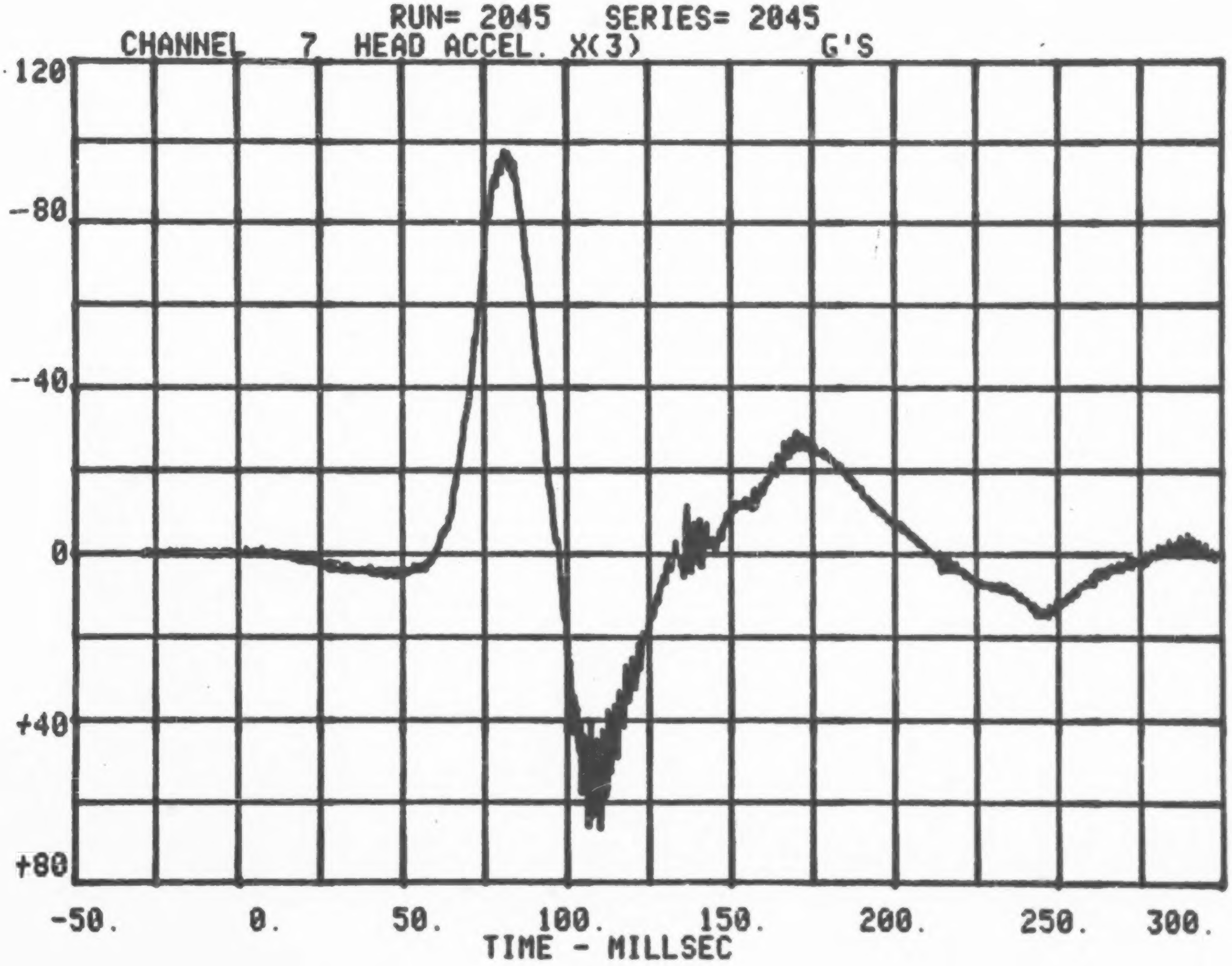
Sled Acceleration

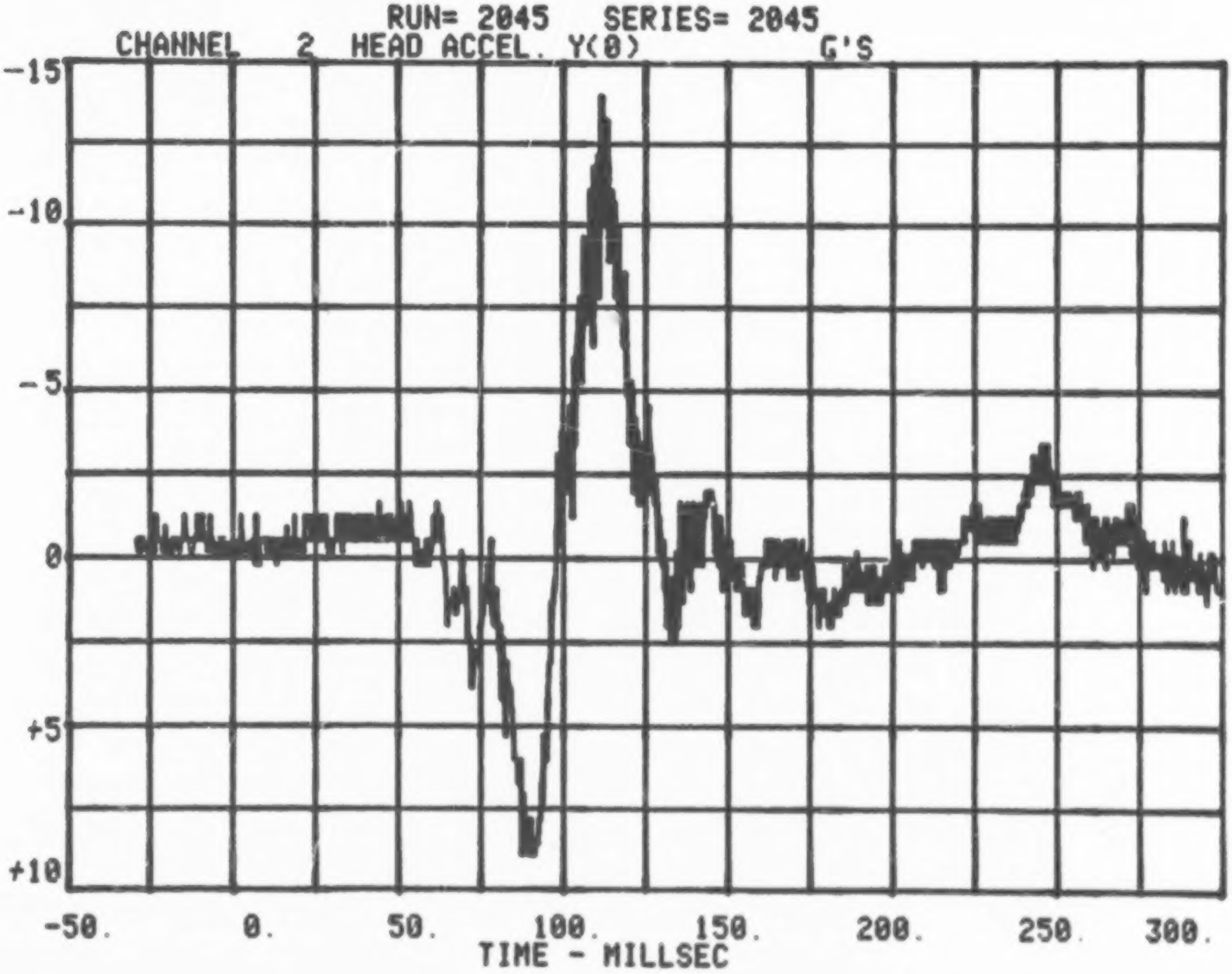
```
                    HEAD INJURY CRITERION
                    HEAD SEVERITY INDEX

               SLED TEST #2045

               RUN=2045

               RESULT. HEAD ACCEL.

HIC=1113.9   FROM T1= .07020   TO T2= .11730

AVERAGE ACCELERATION BETWEEN T1 AND T2=  56.2G'S

EVENT TIME= 300.0  MSEC

SEVERITY INDEX=1579.0
```

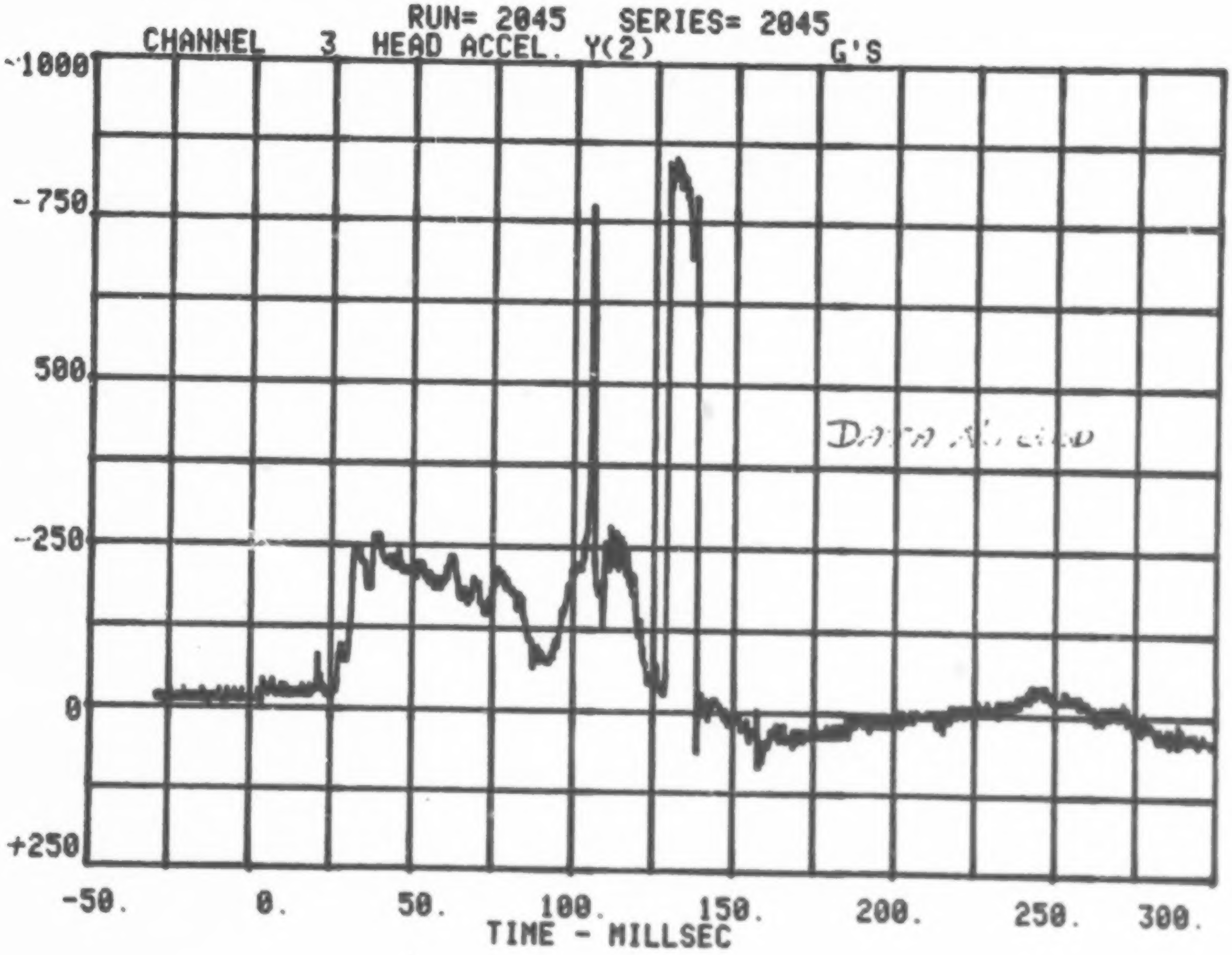
BEST DOCUMENT AVAILABLE

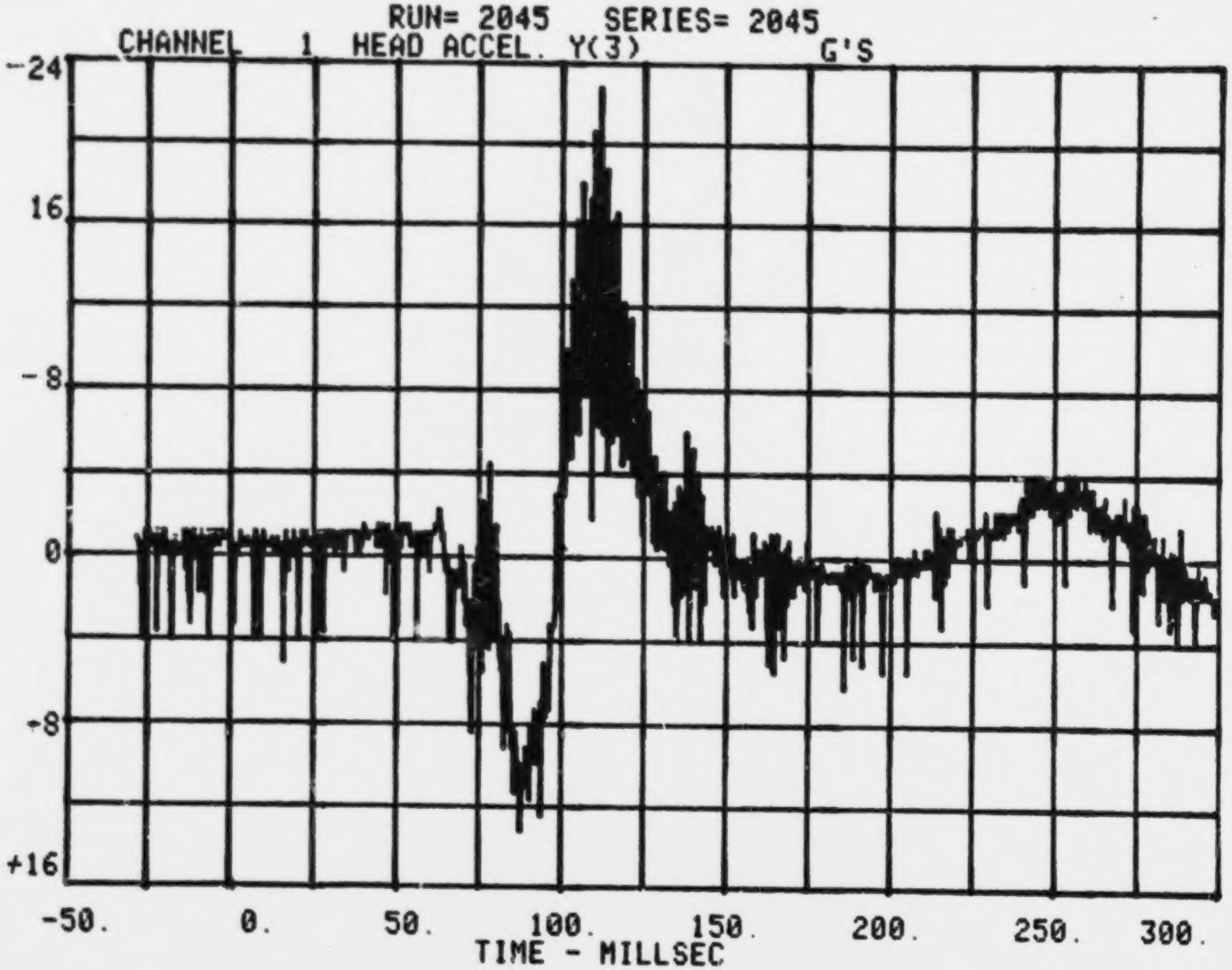

RUN= 2045 SERIES= 2045
CHANNEL 9 HEAD ACCEL. X(0) G'S
-160
-120
-80
-40
0
+40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2045 SERIES= 2045
CHANNEL 10 HEAD ACCEL. X(1) G'S
-120
-80
-40
0
+40
+80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

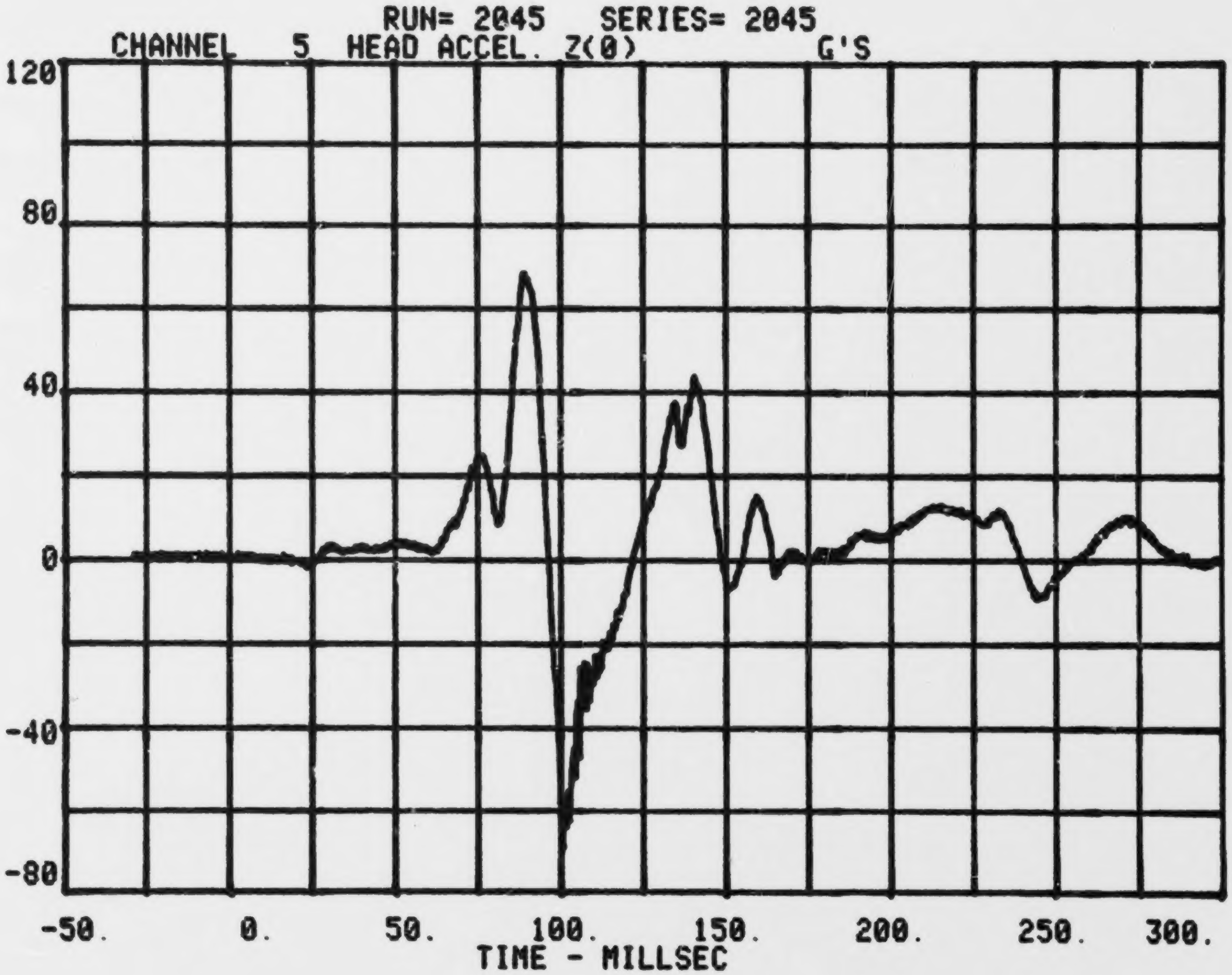

RUN= 2045 SERIES= 2045
CHANNEL 7 HEAD ACCEL. X(3) G'S
120
-80
-40
0
+40
+80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

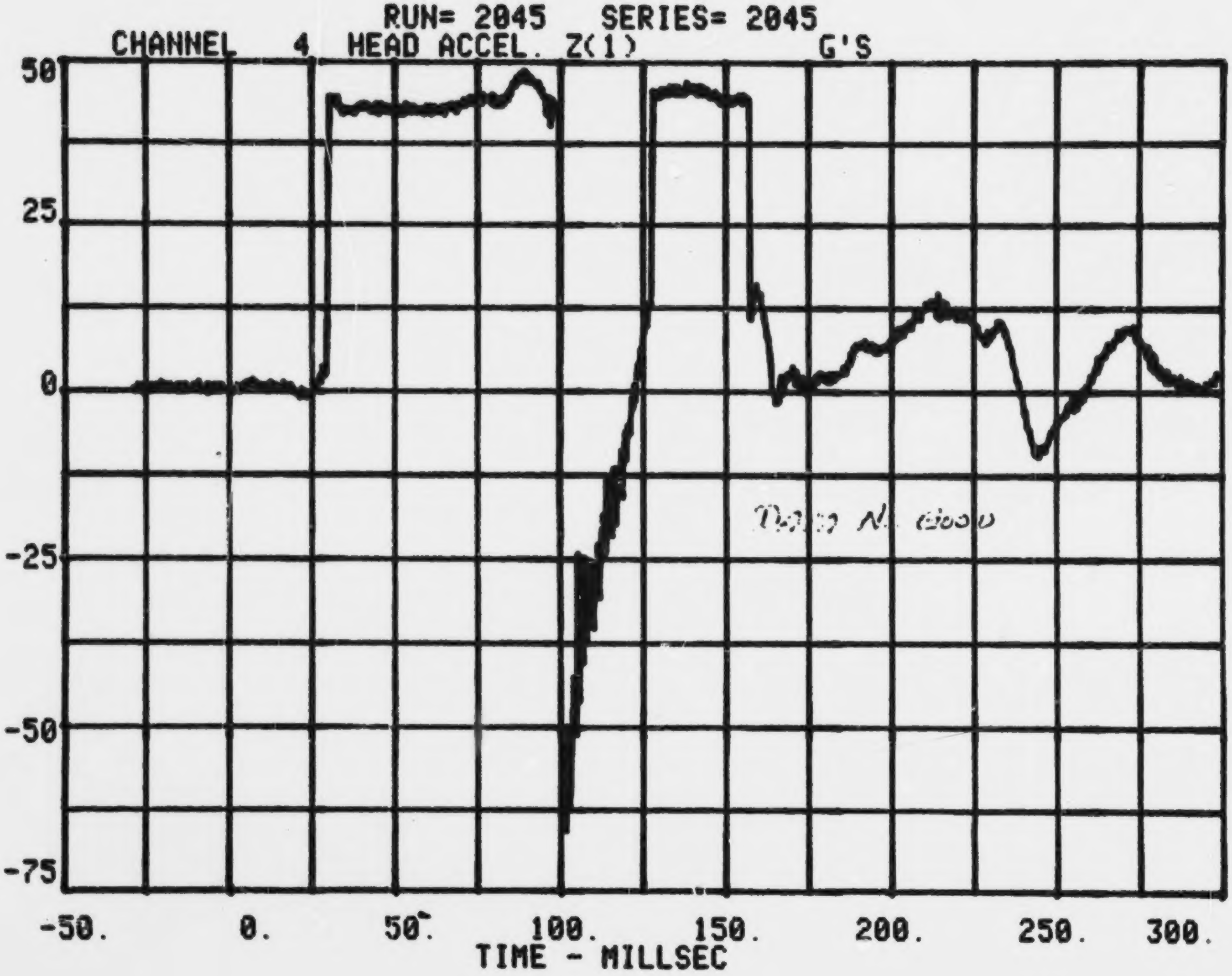

RUN= 2045 SERIES= 2045
CHANNEL 2 HEAD ACCEL. Y(0) G'S
-15
-10
-5
0
+5
+10
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

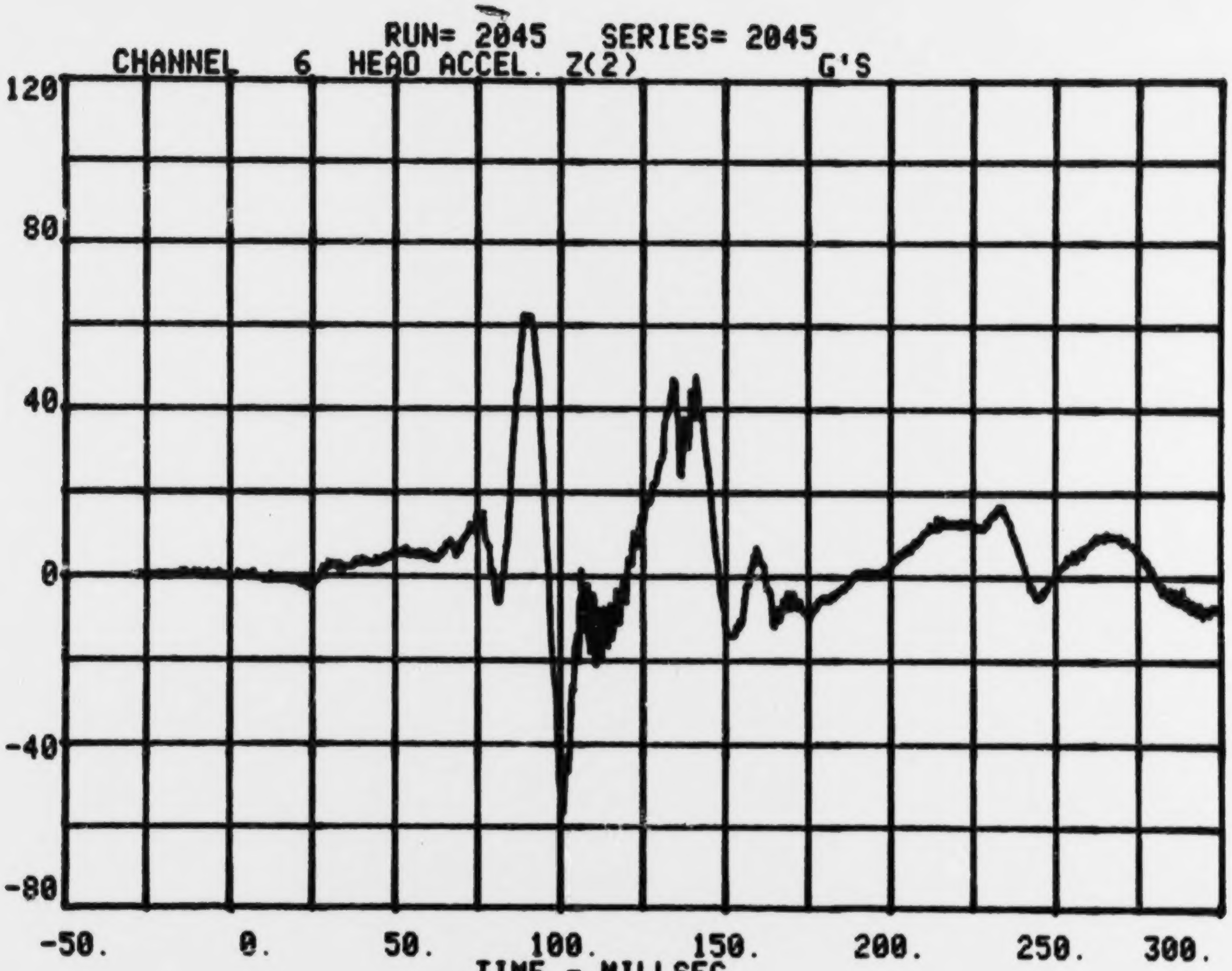

RUN= 2045 SERIES= 2045
CHANNEL 3 HEAD ACCEL. Y(2) G'S
-1000
-750
500
-250
0
+250
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC
DATA ALTERED

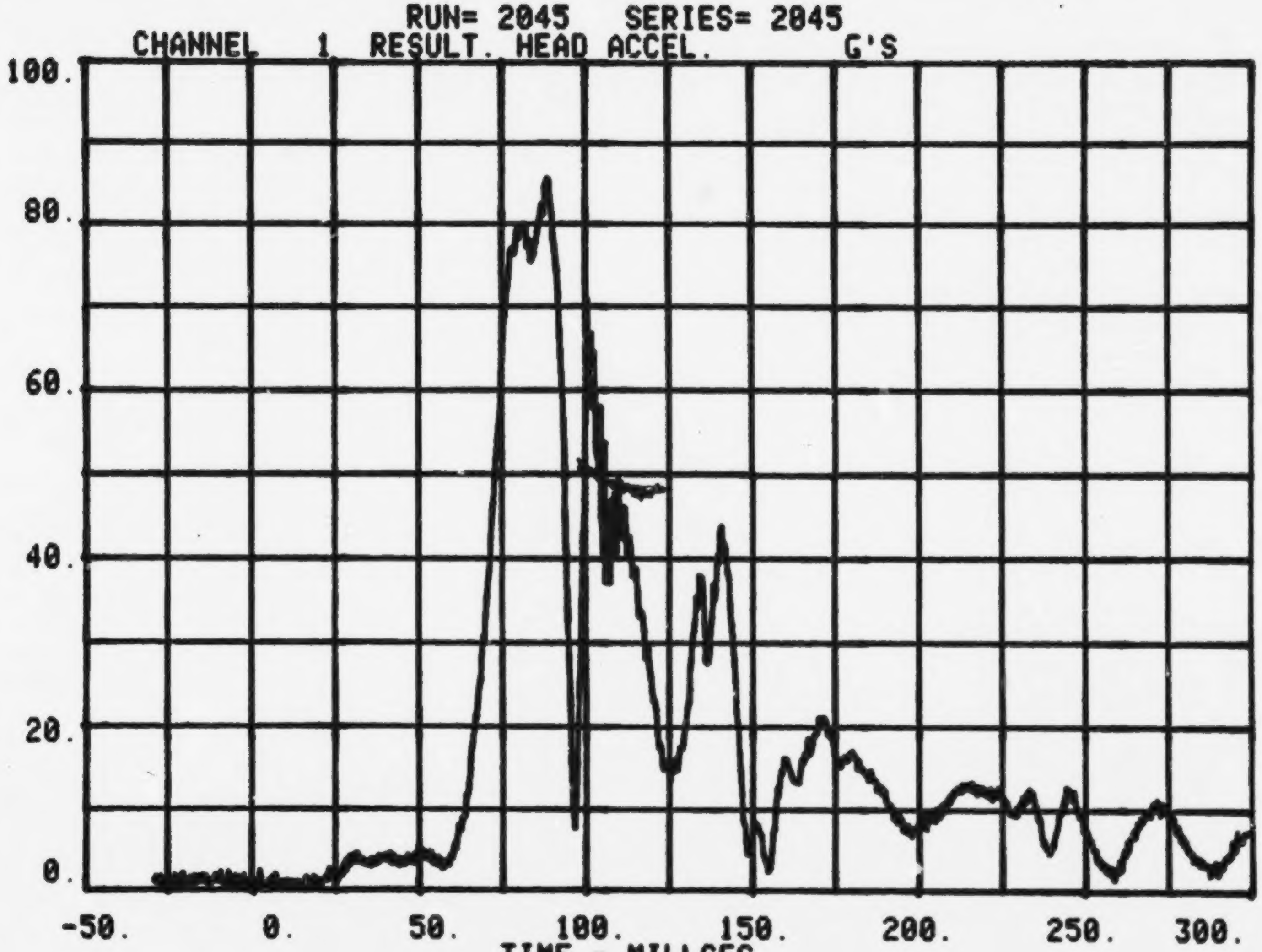

RUN= 2045 SERIES= 2045
CHANNEL 1 HEAD ACCEL. Y(3) G'S
-24
16
-8
0
-8
+16
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

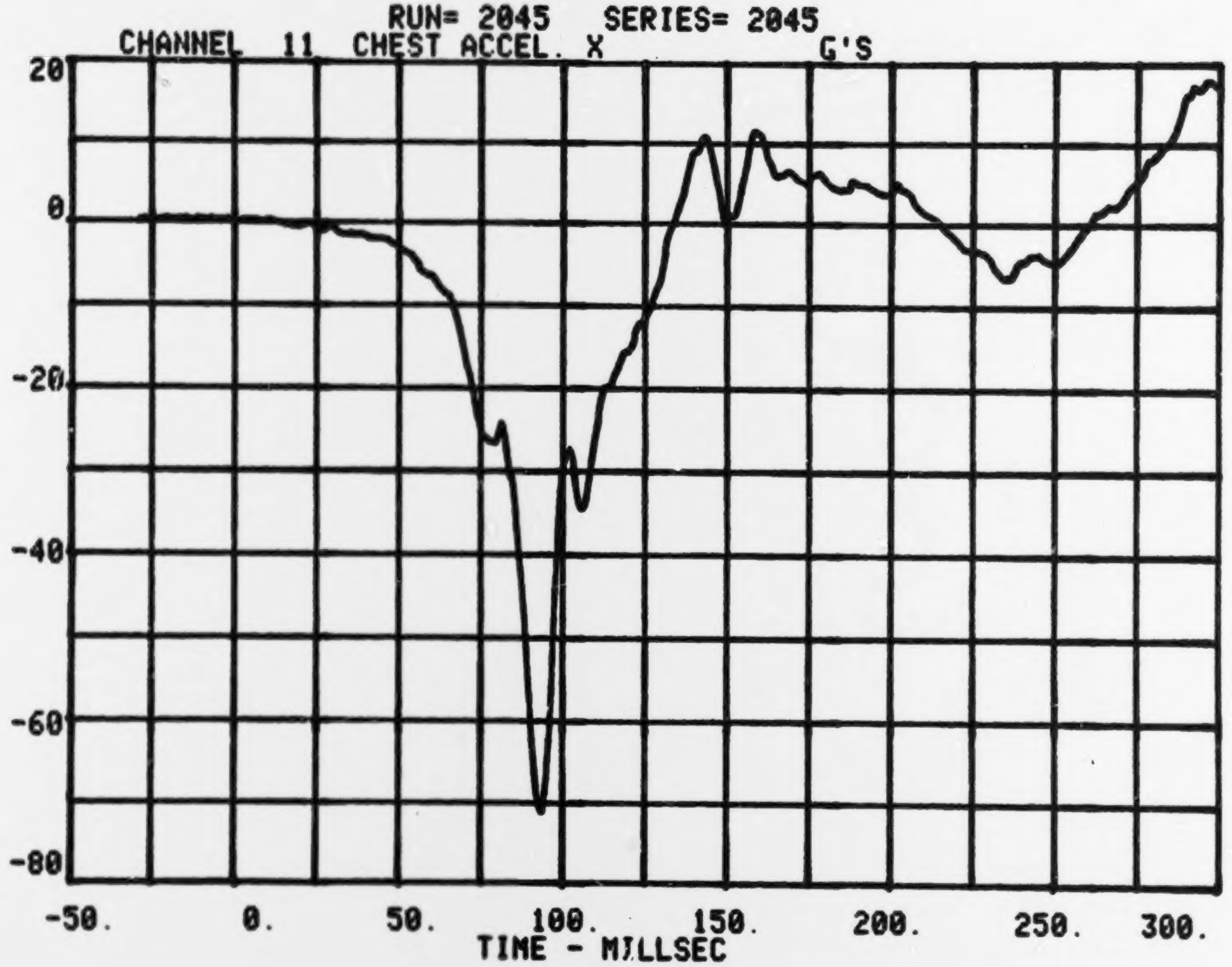
BEST DOCUMENT AVAILABLE



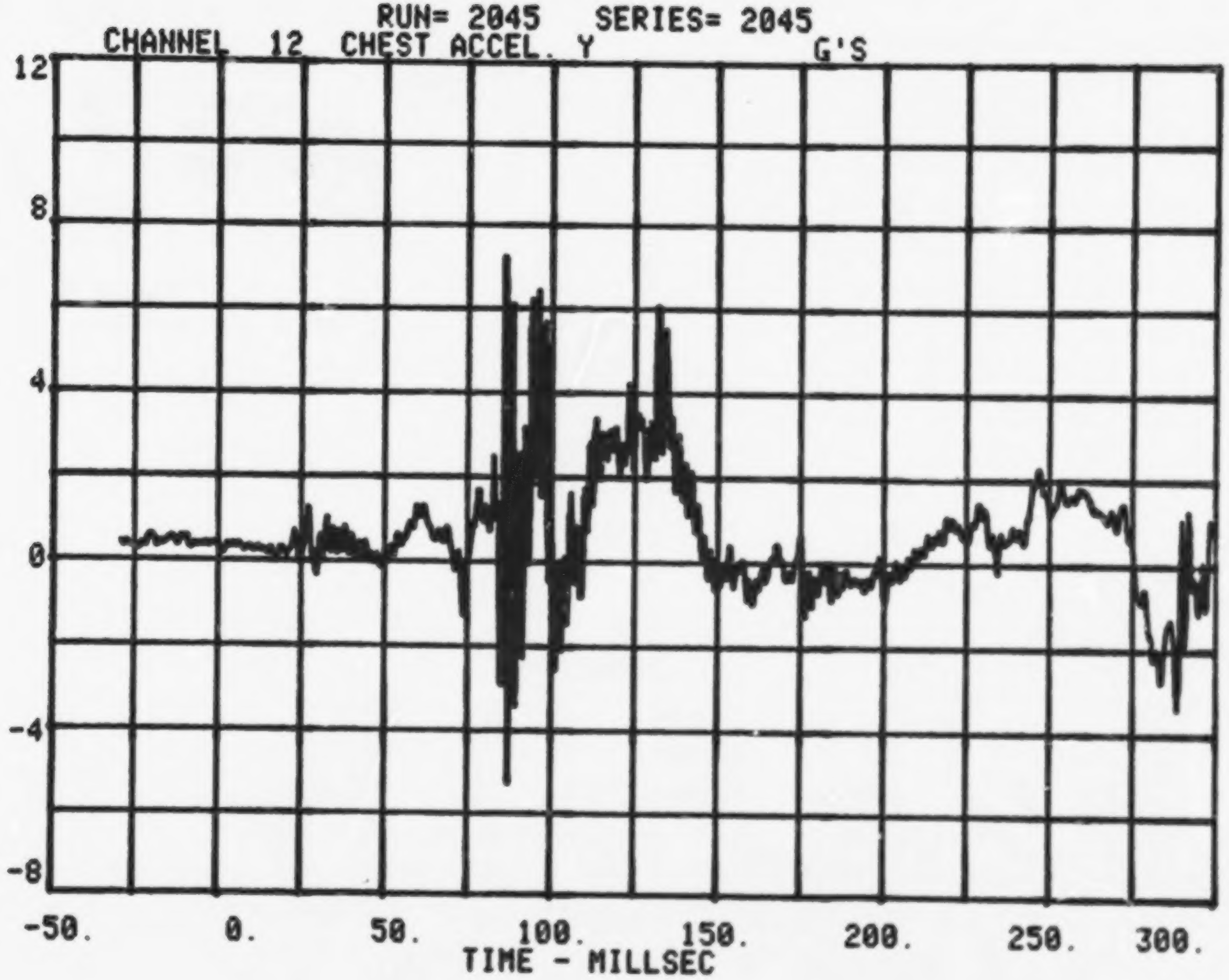

RUN= 2045 SERIES= 2045
CHANNEL 4 HEAD ACCEL. Z(1) G'S
50
25
0
-25
-50
-75
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC
Data No Good


RUN= 2045 SERIES= 2045
CHANNEL 6 HEAD ACCEL. Z(2) G'S
120
80
40
0
-40
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

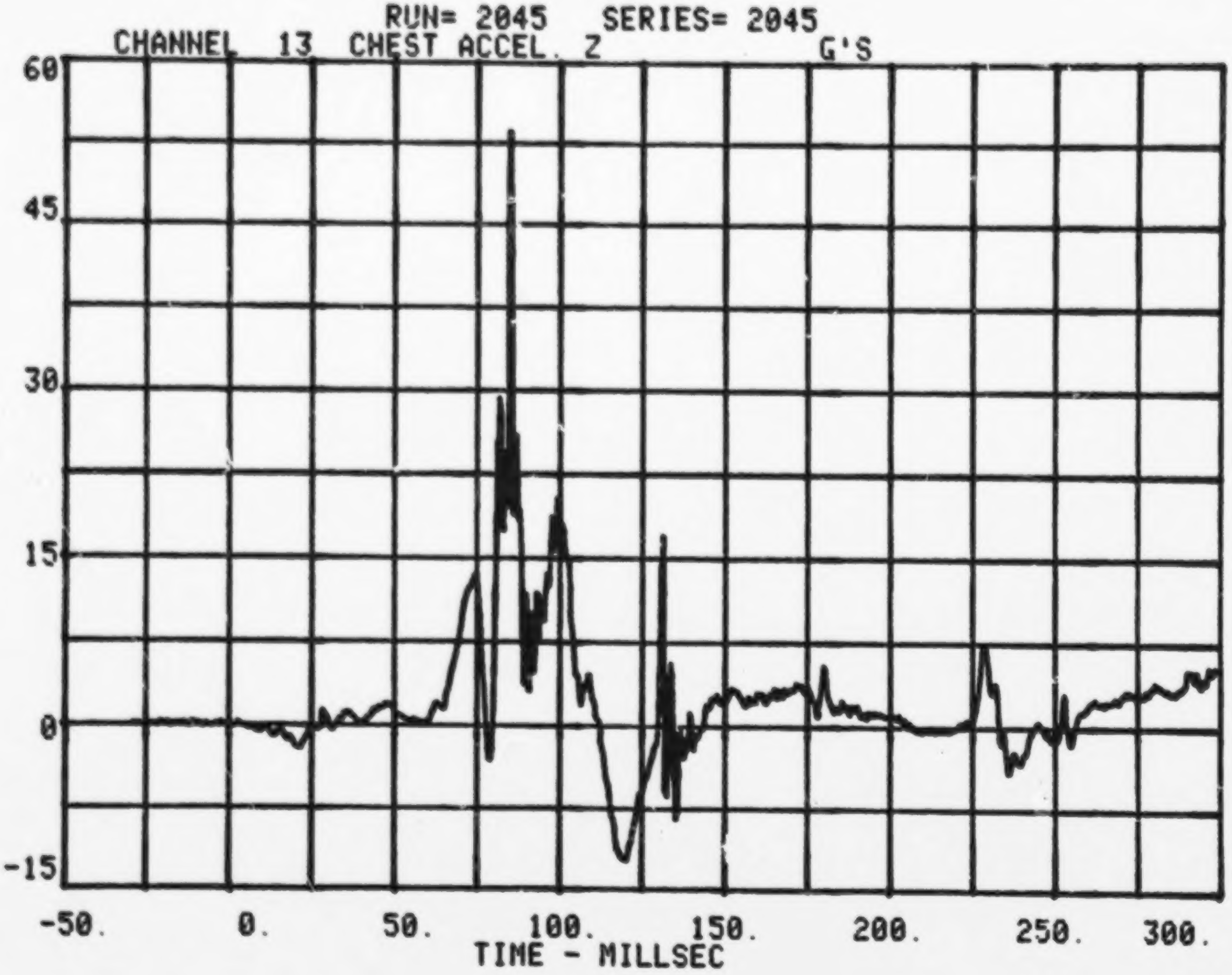

RUN= 2045 SERIES= 2045
CHANNEL 1 RESULT. HEAD ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

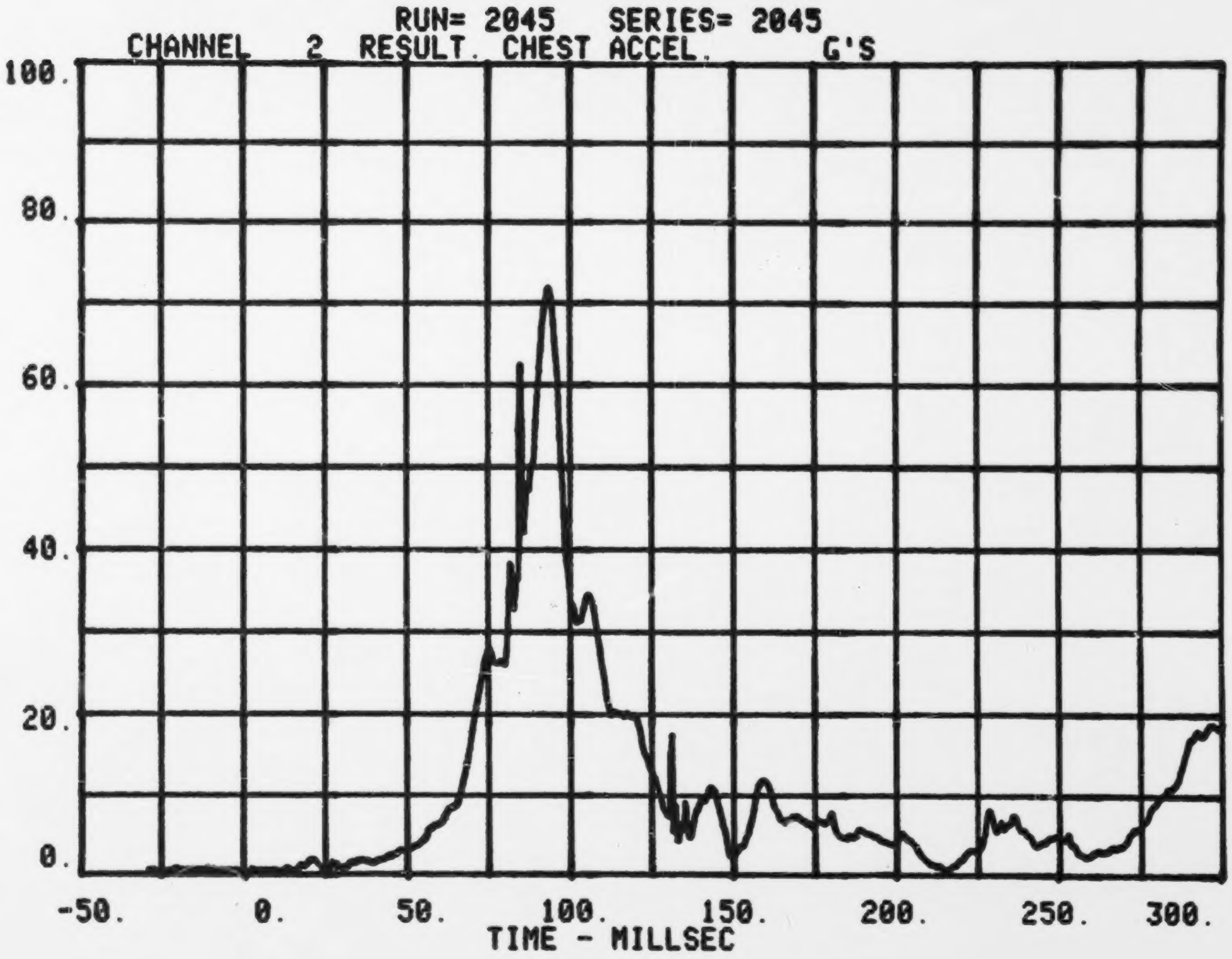

RUN= 2045 SERIES= 2045
CHANNEL 11 CHEST ACCEL. X
G'S
20
0
-20
-40
-60
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

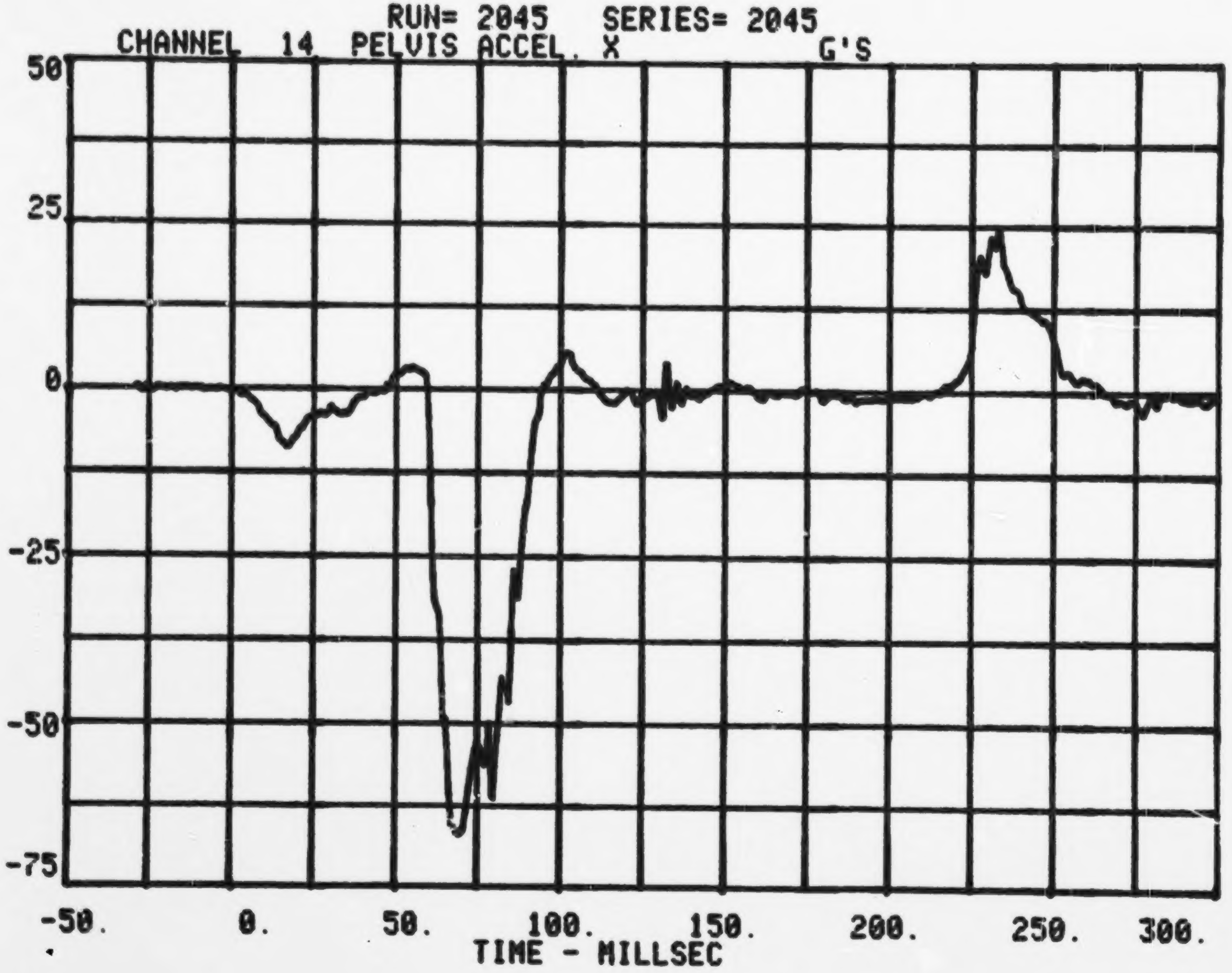
BEST DOCUMENT AVAILABLE



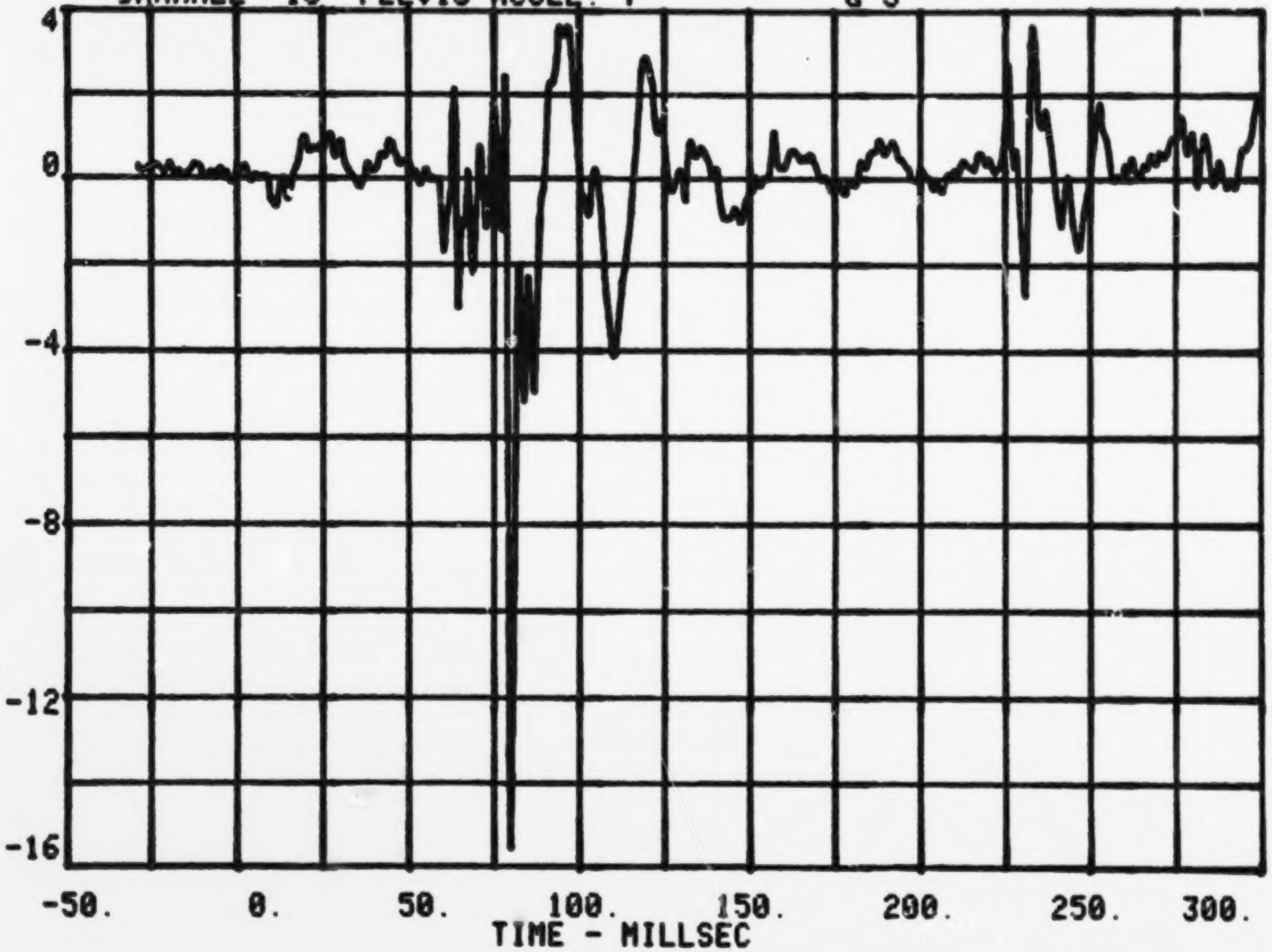
BEST DOCUMENT AVAILABLE

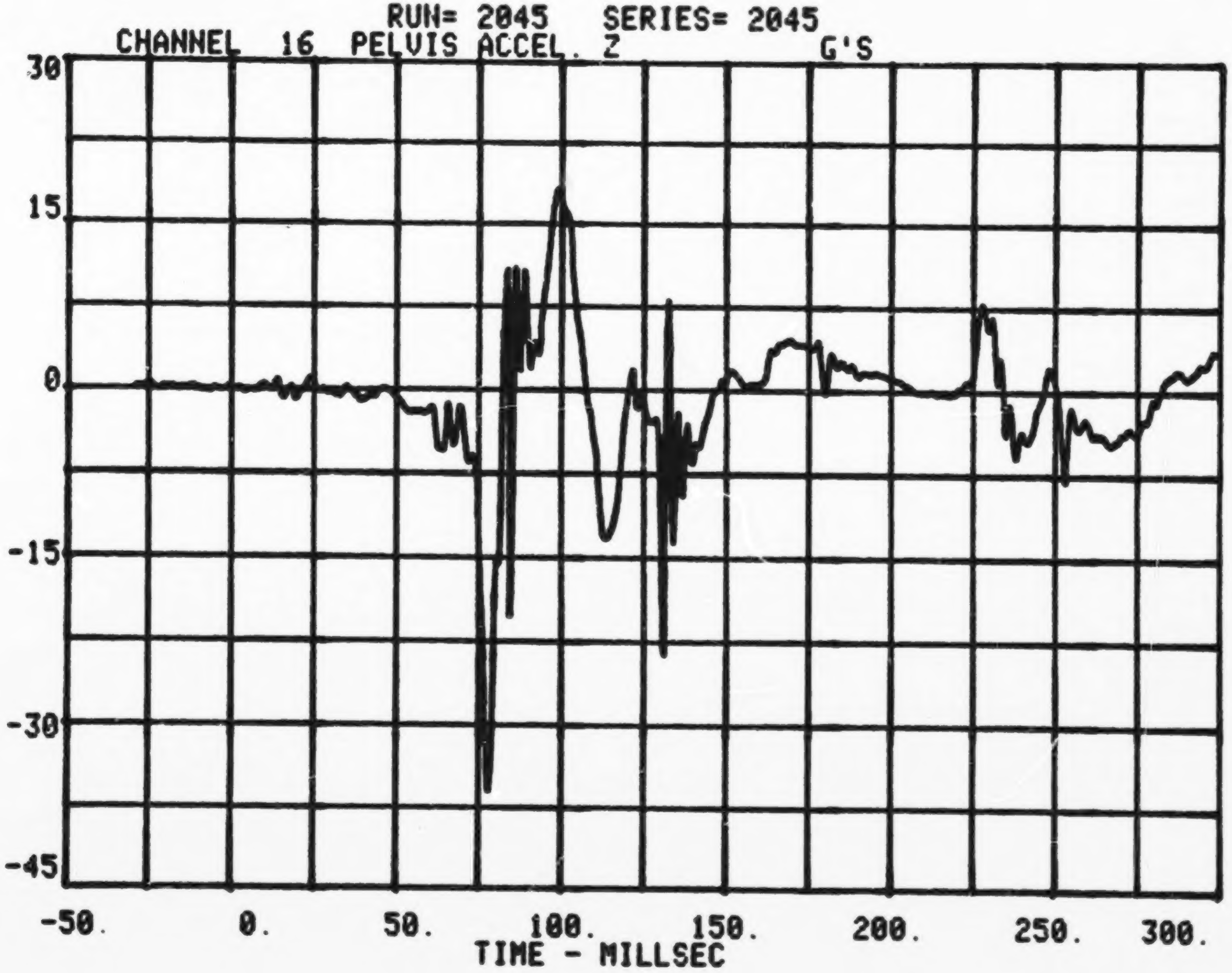


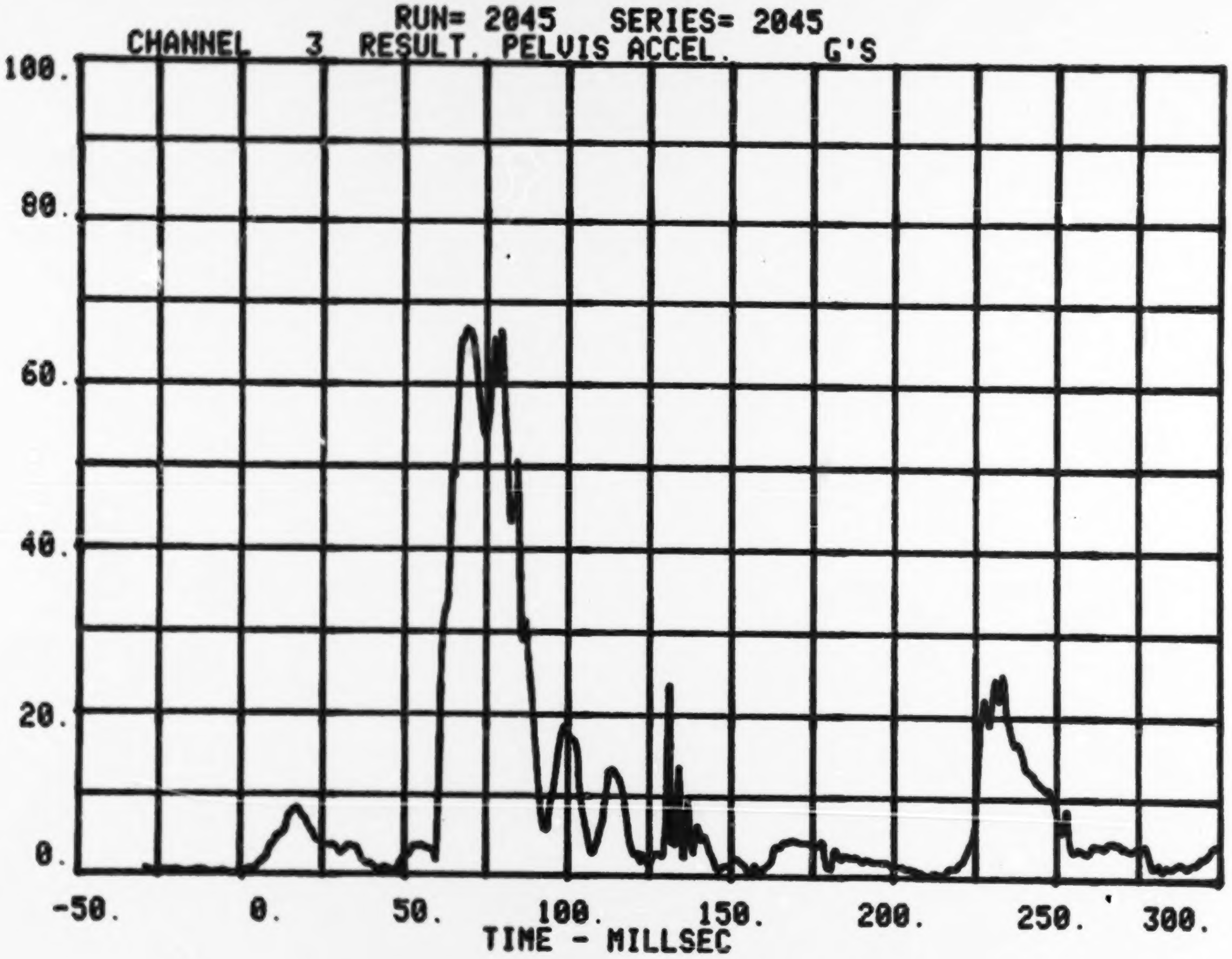

RUN= 2045 SERIES= 2045
CHANNEL 2 RESULT. CHEST ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

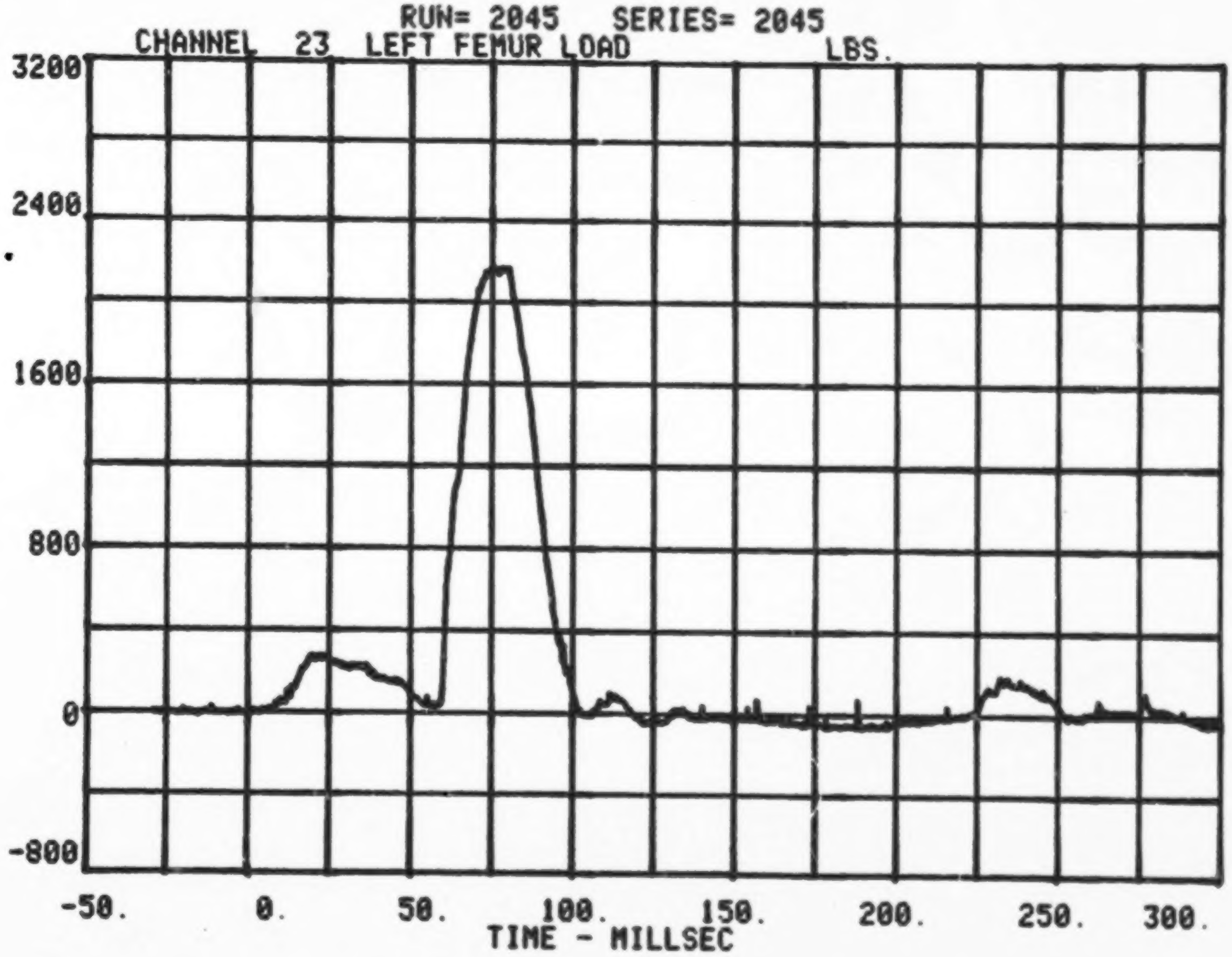

RUN= 2045 SERIES= 2045
CHANNEL 14 PELVIS ACCEL. X G'S
50
25
0
-25
-50
-75
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

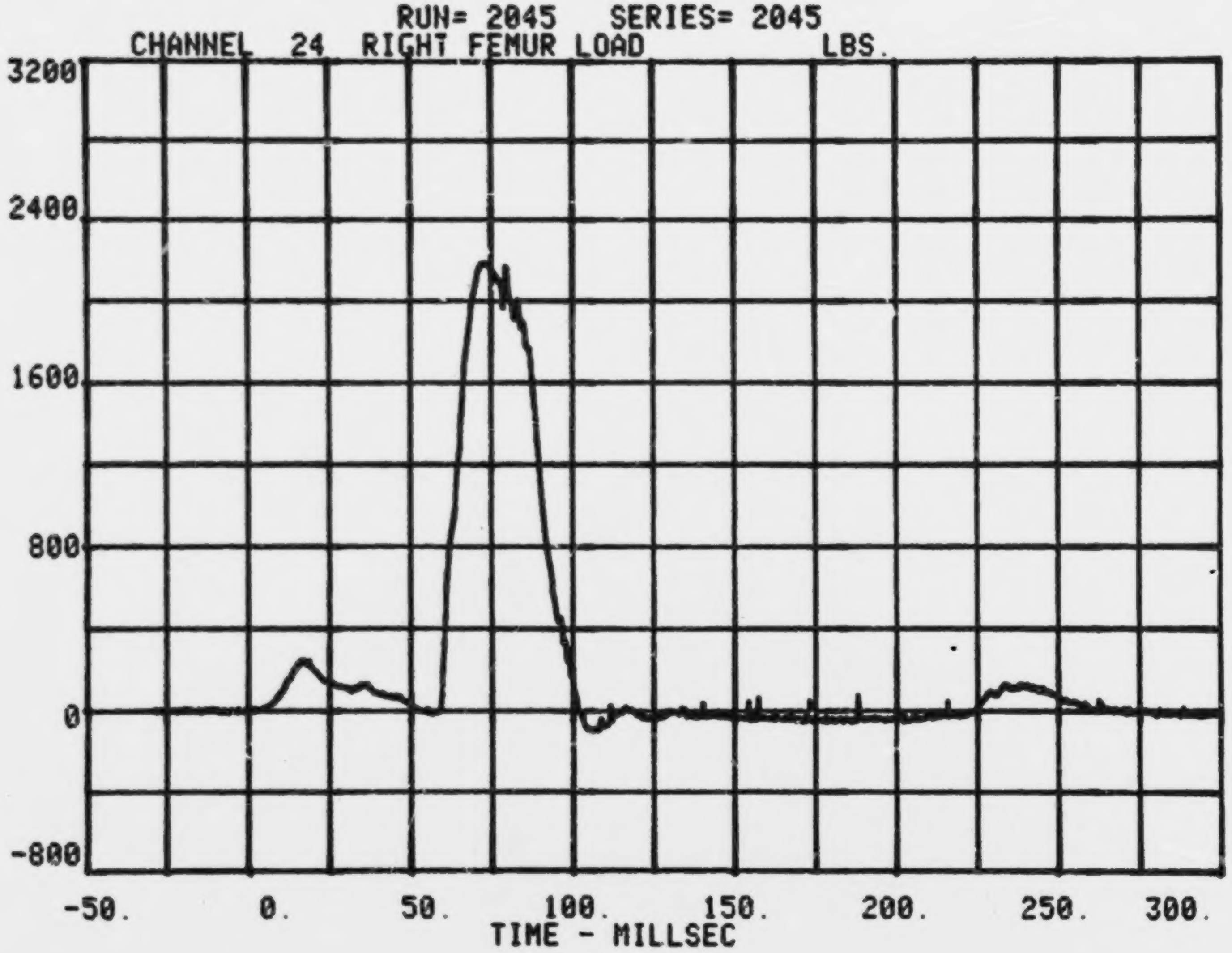
RUN= 2045 SERIES= 2045
CHANNEL 15 PELVIS ACCEL. Y G'S



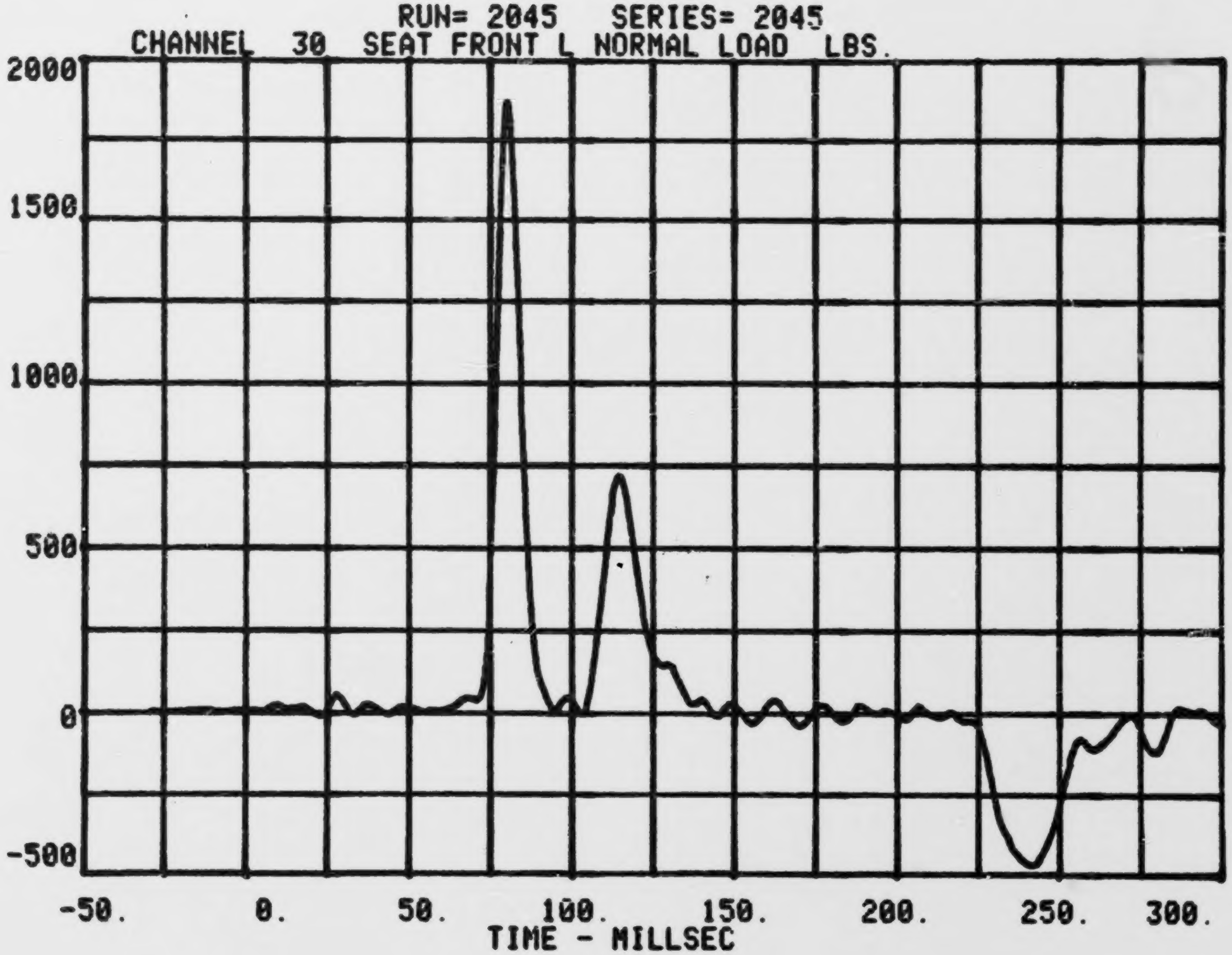

RUN= 2045 SERIES= 2045
CHANNEL 16 PELVIS ACCEL. Z
G'S
30
15
0
-15
-30
-45
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2045 SERIES= 2045
CHANNEL 3 RESULT. PELVIS ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2045 SERIES= 2045
CHANNEL 23 LEFT FEMUR LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

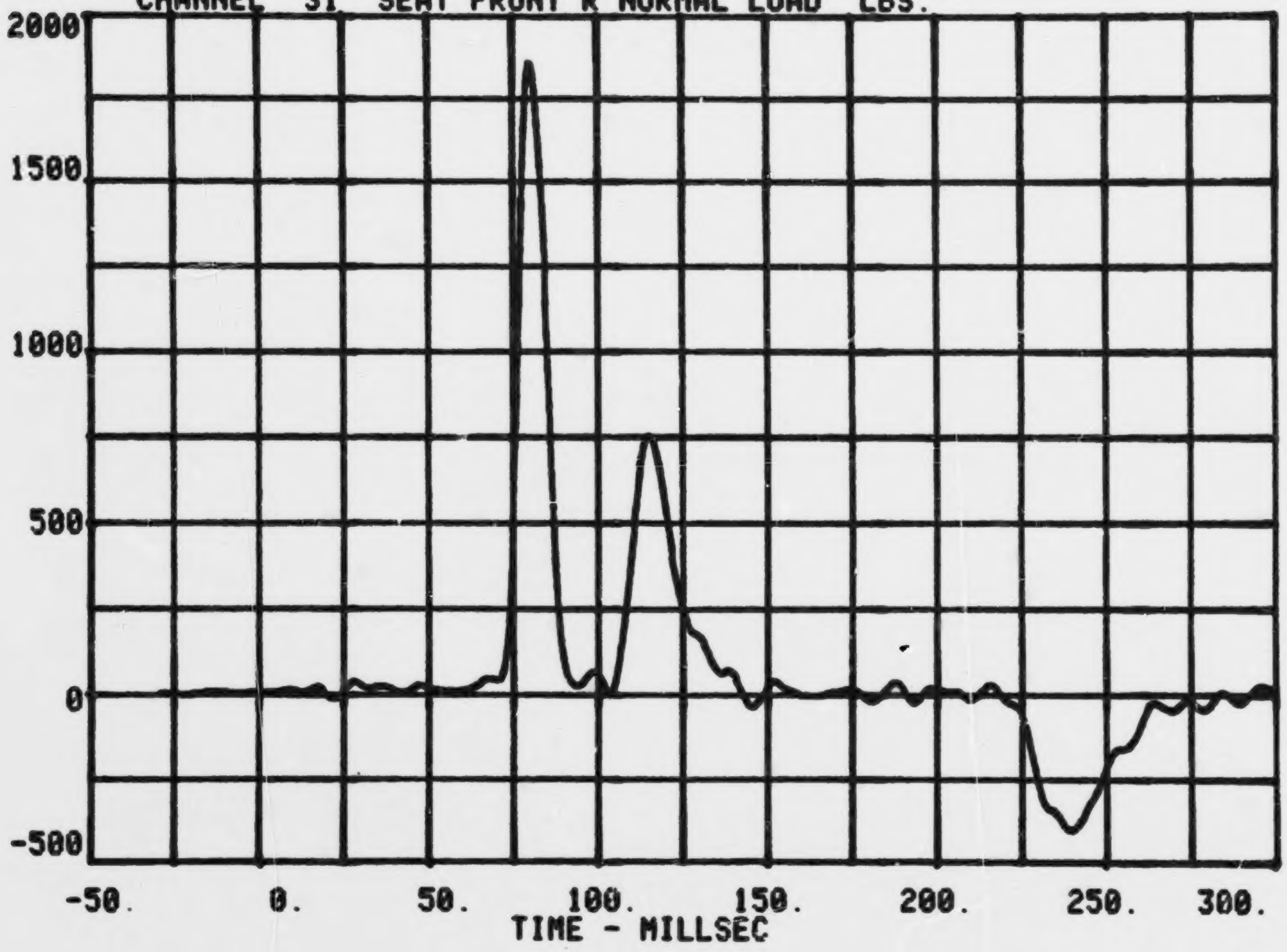

RUN= 2045 SERIES= 2045
CHANNEL 24 RIGHT FEMUR LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

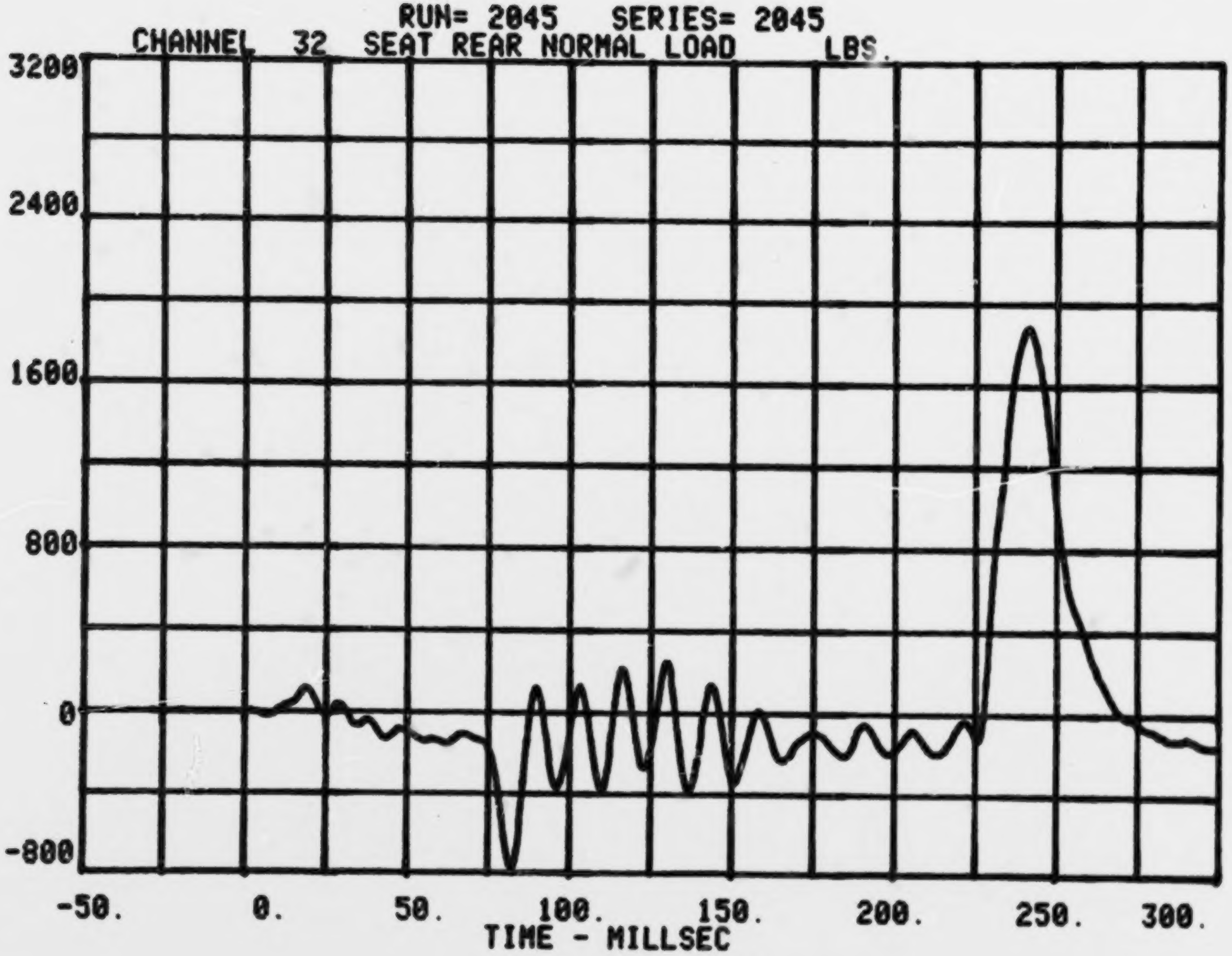
BEST DOCUMENT AVAILABLE



RUN= 2045 SERIES= 2045

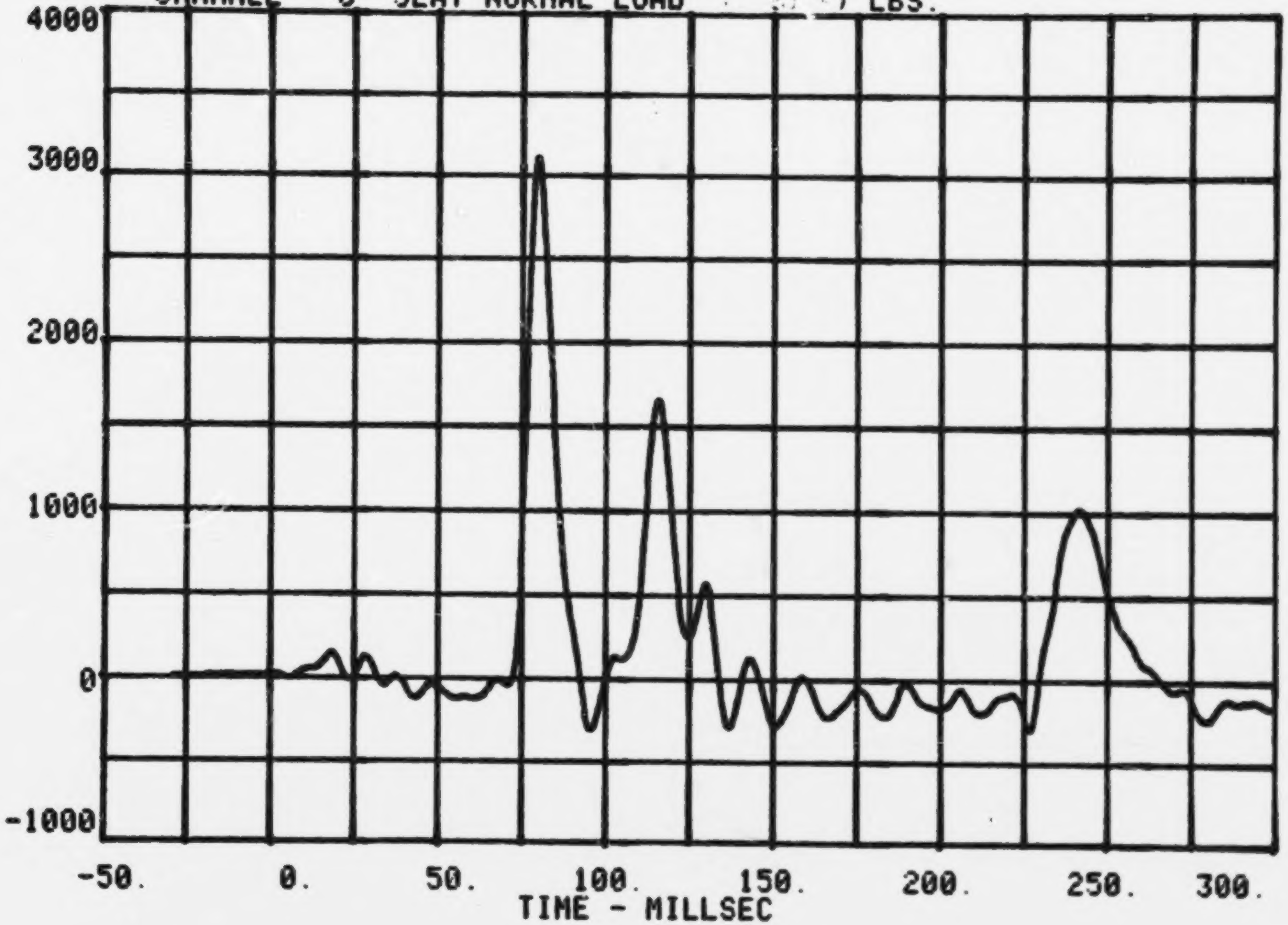
CHANNEL 31 SEAT FRONT R NORMAL LOAD LBS.

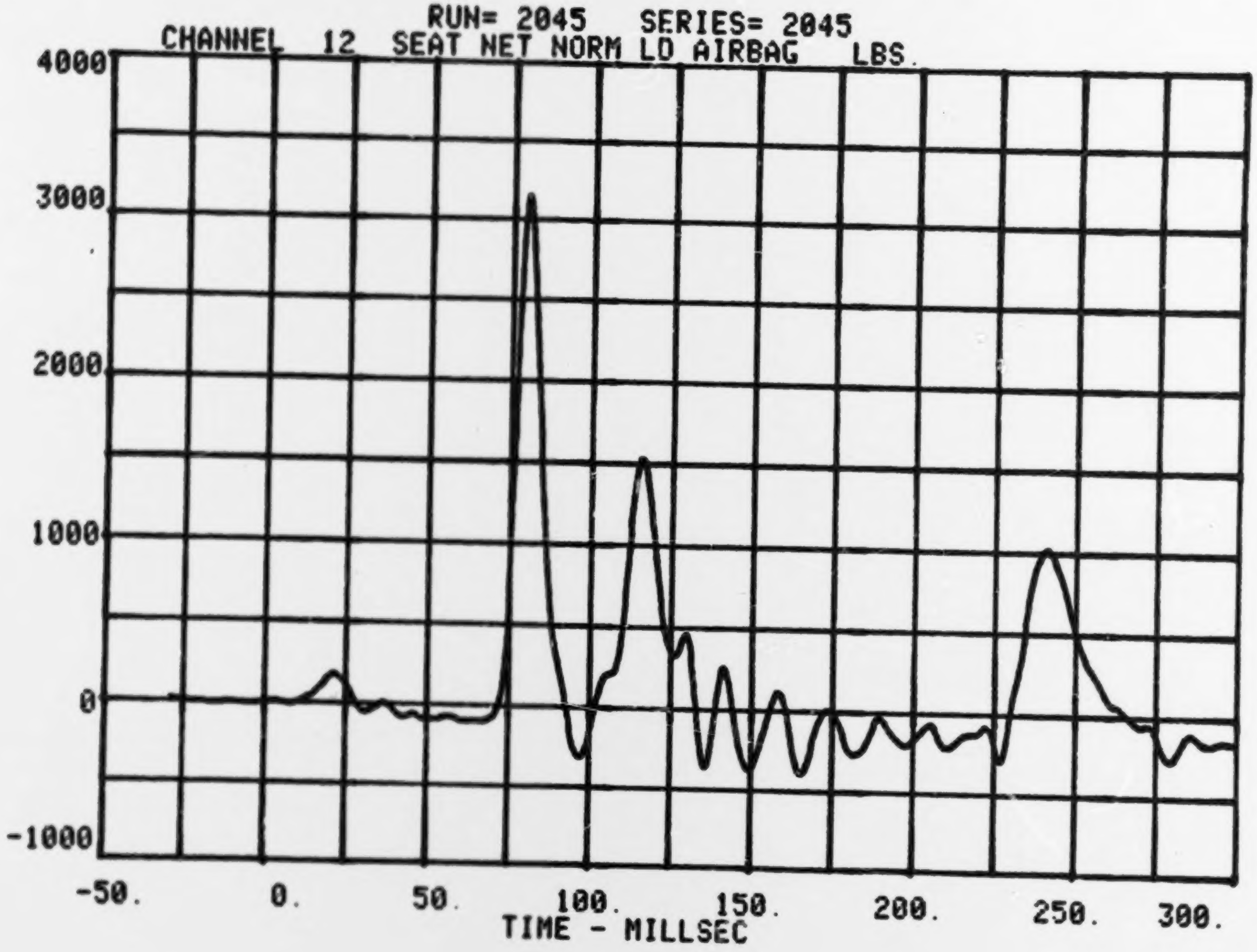


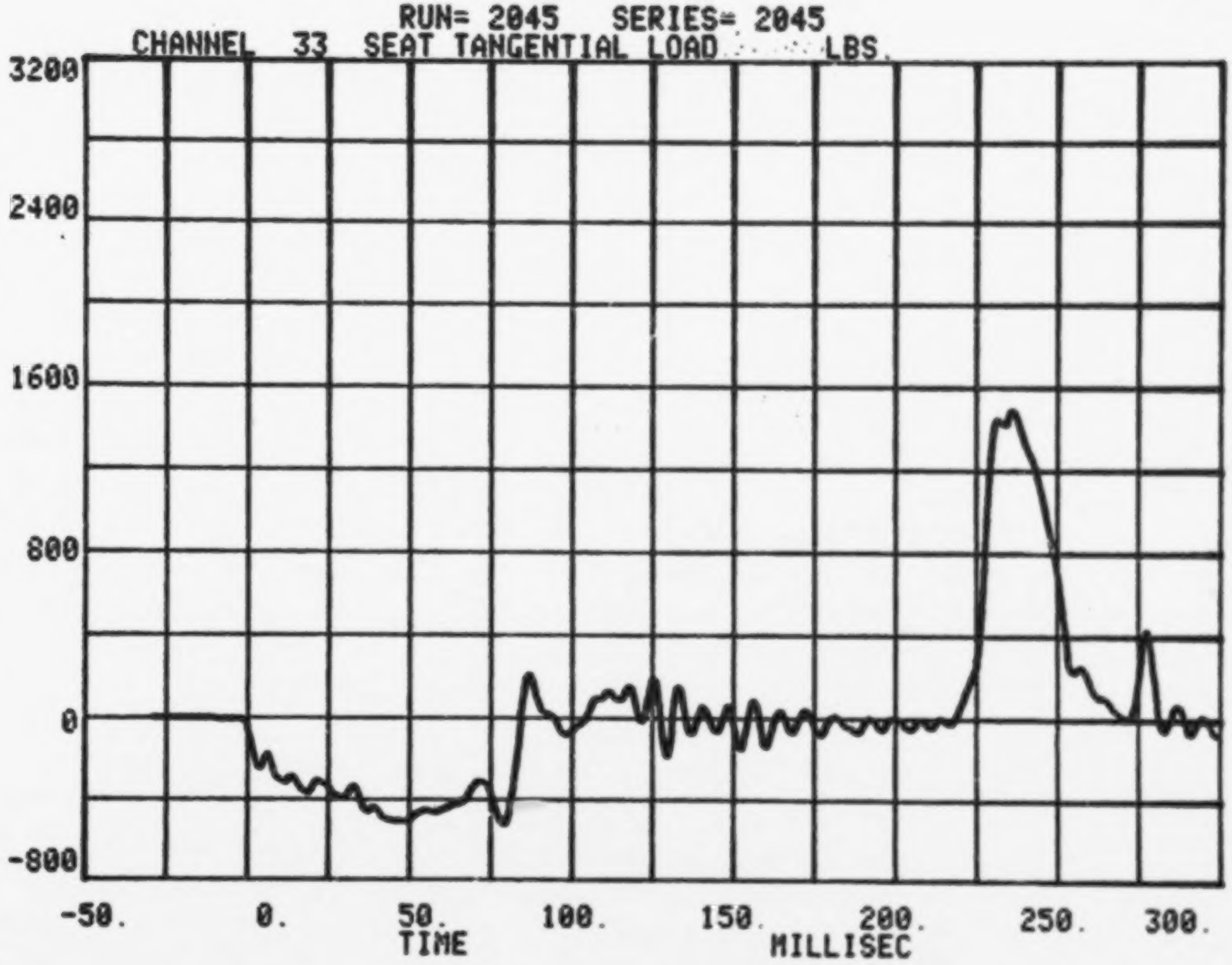


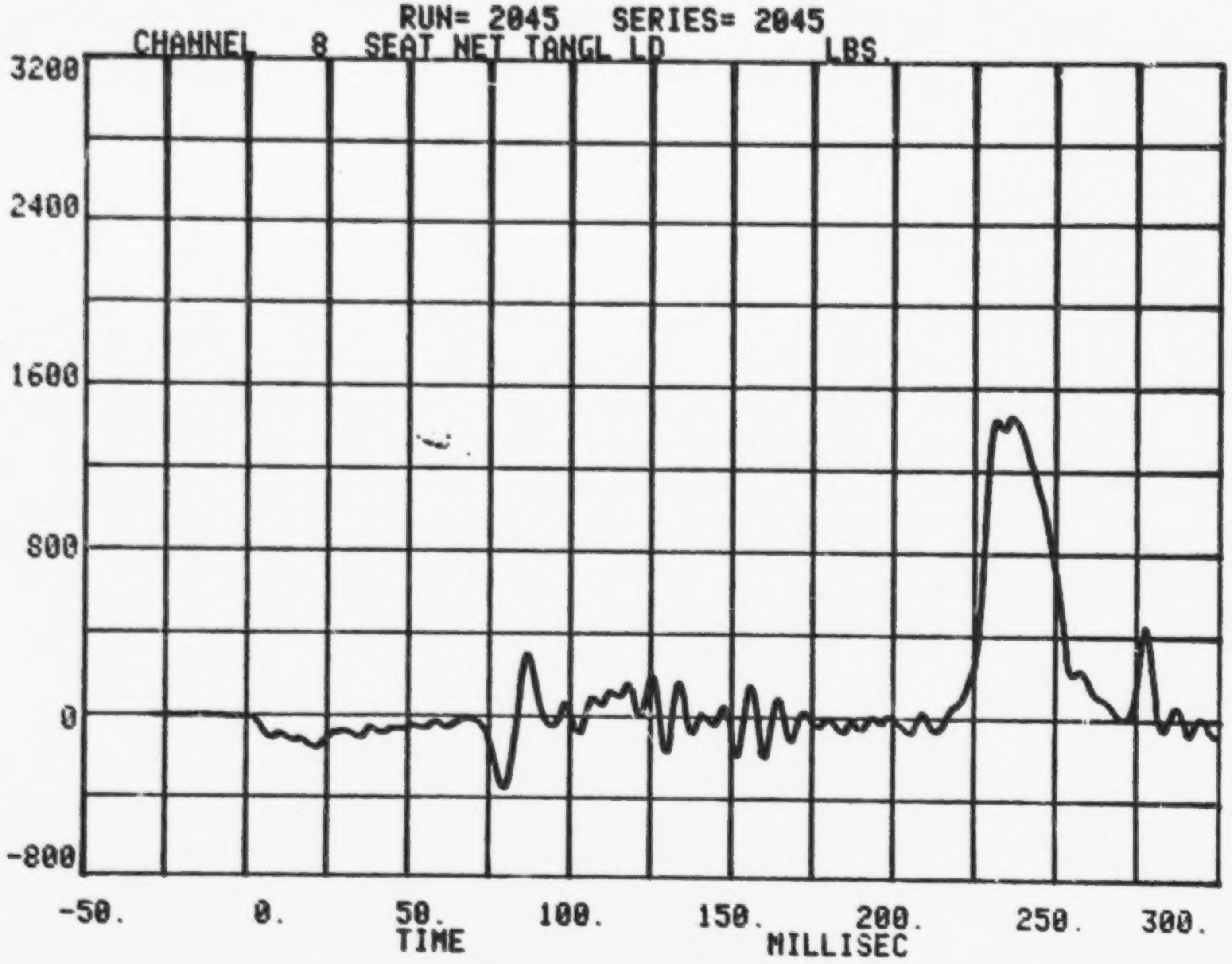
RUN= 2045 SERIES= 2045
CHANNEL 32 SEAT REAR NORMAL LOAD LBS.

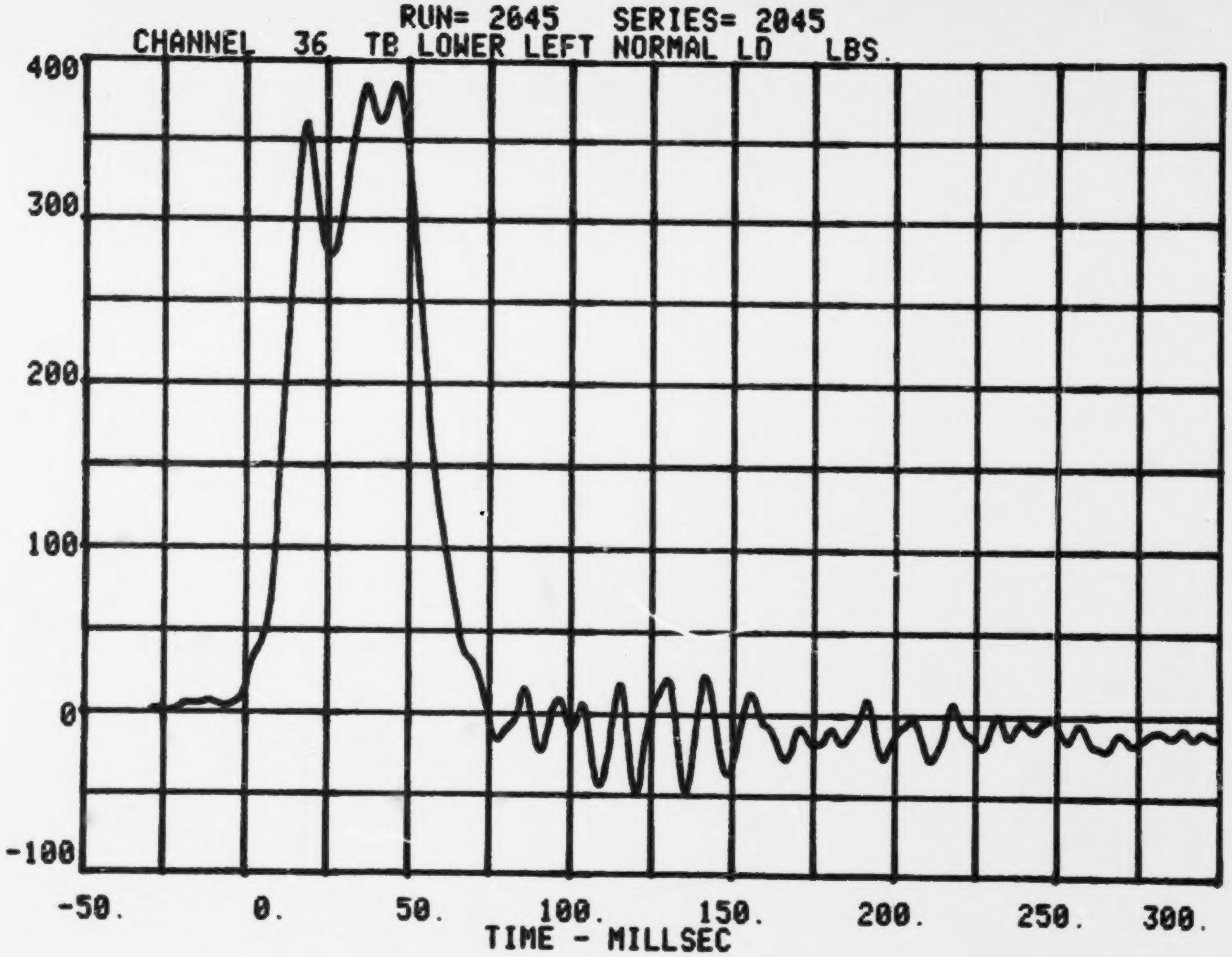
RUN= 2045 SERIES= 2045
CHANNEL 8 SEAT NORMAL LOAD [illegible]) LBS.

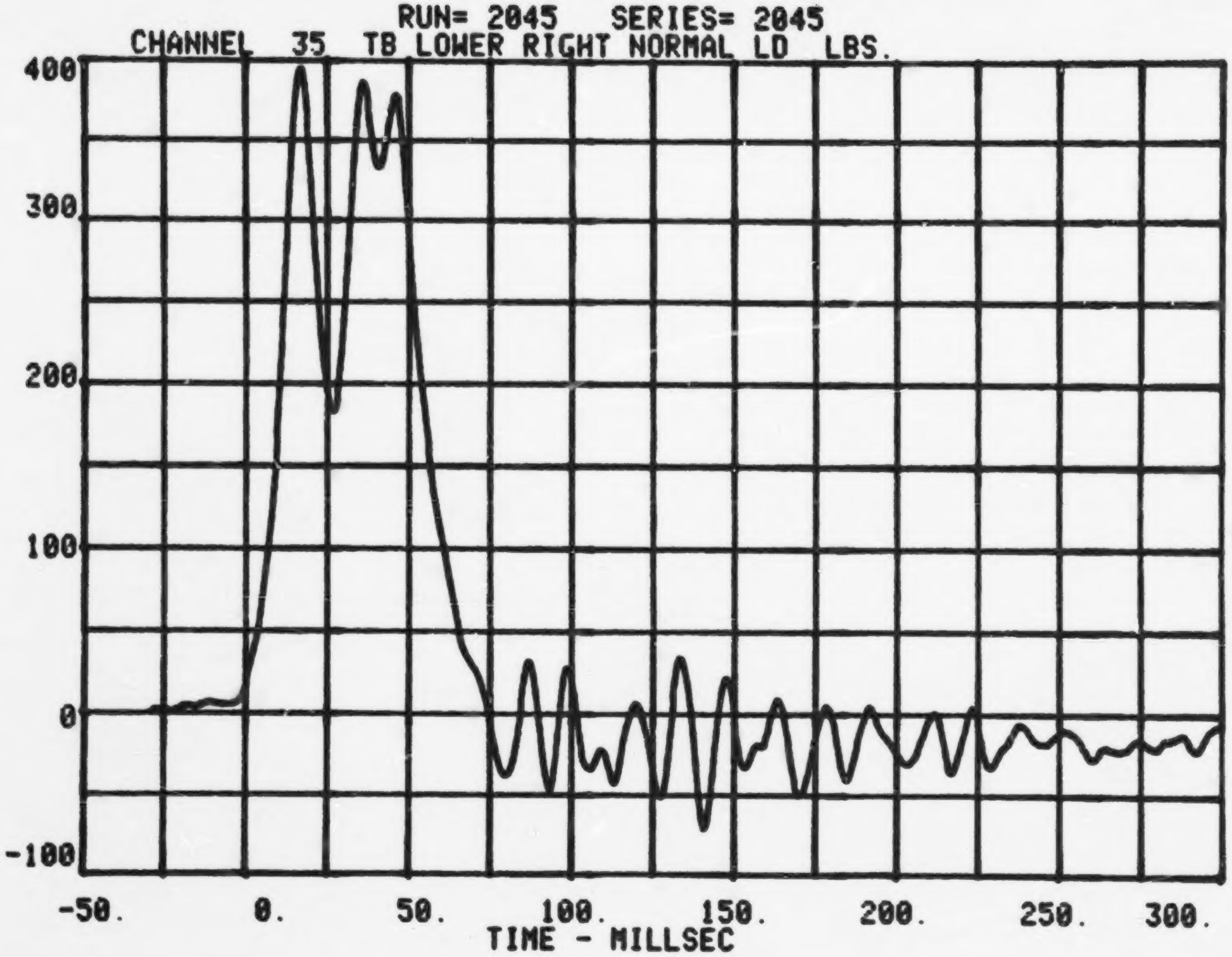


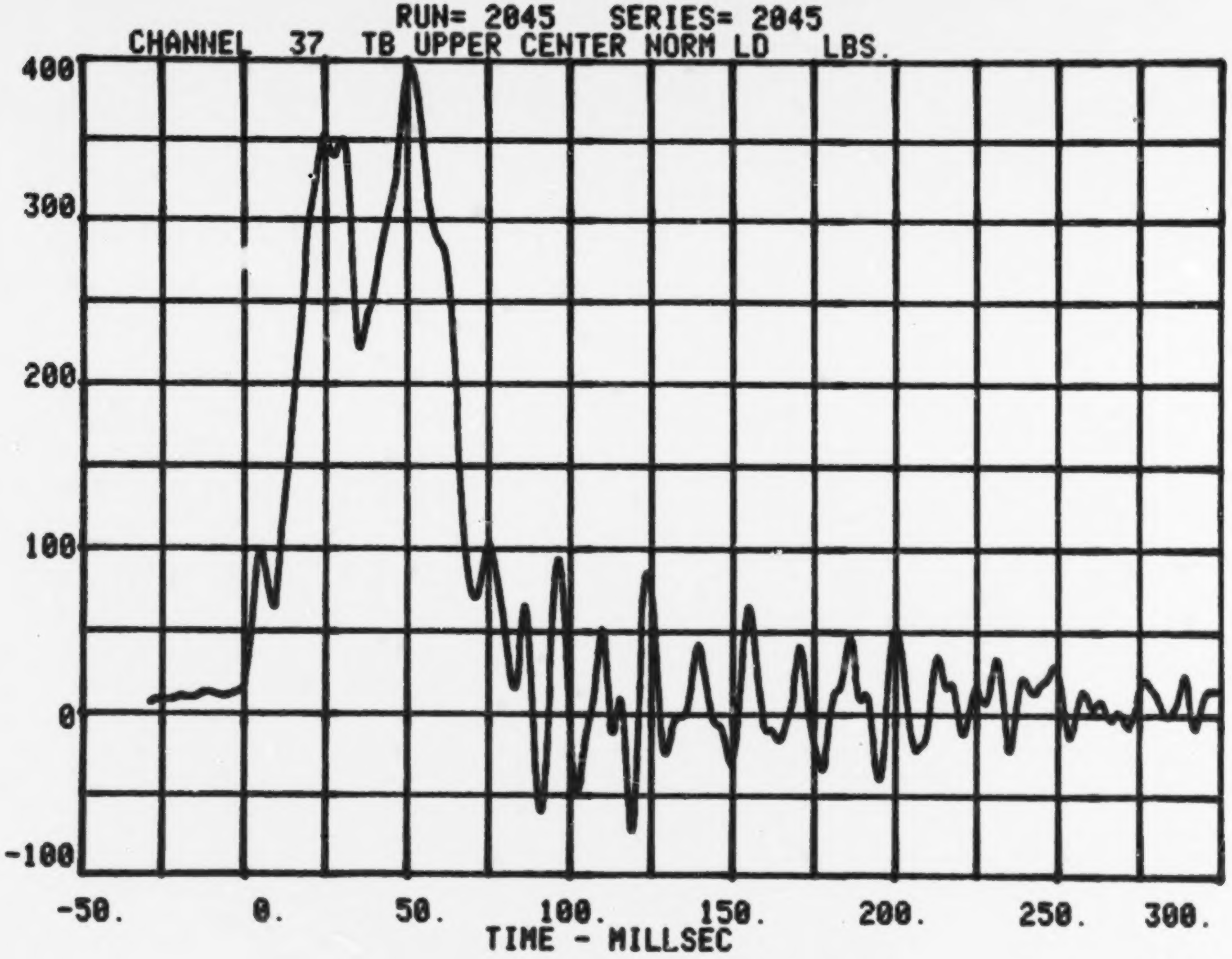

RUN= 2045 SERIES= 2045
CHANNEL 12 SEAT NET NORM LD AIRBAG LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

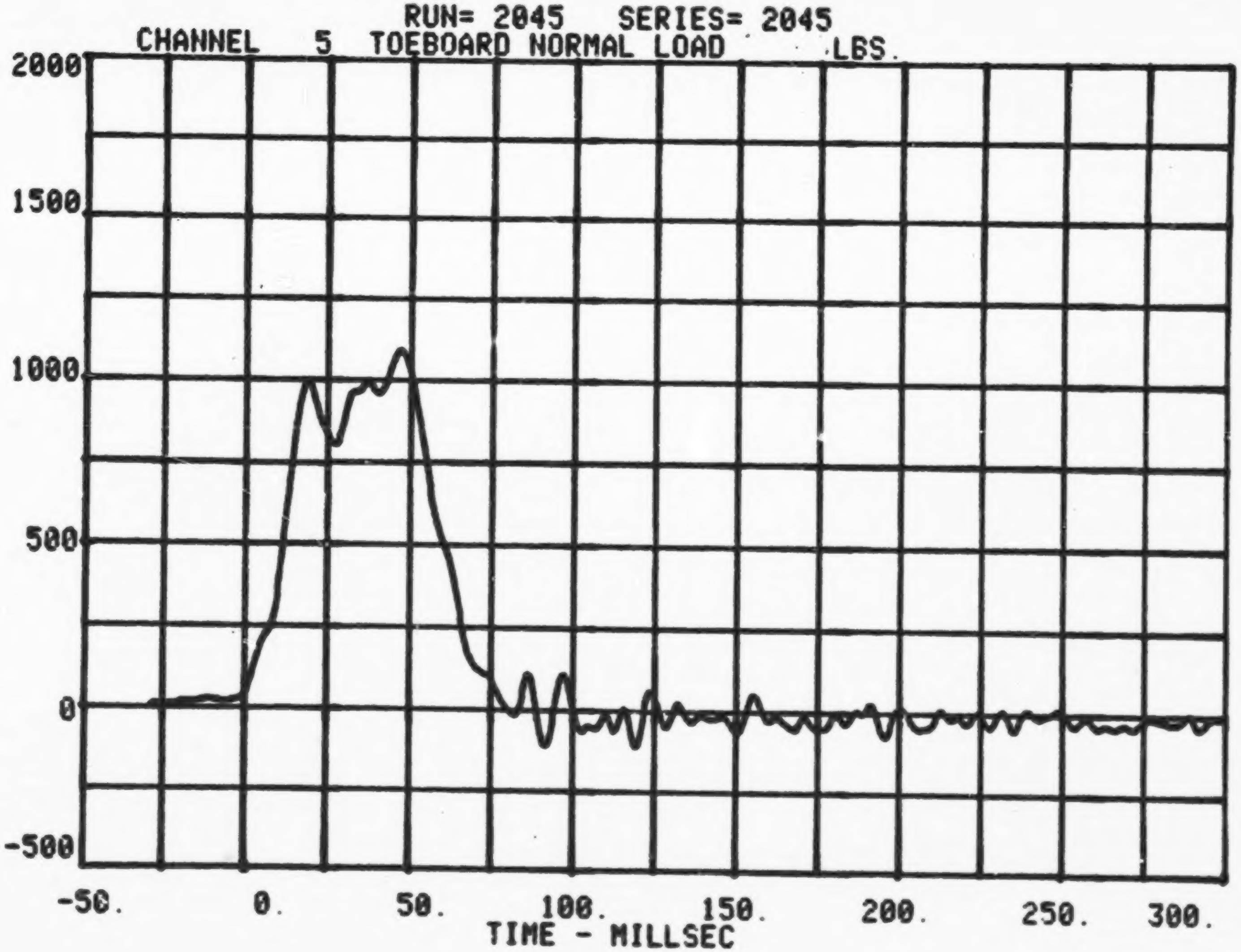

RUN= 2045 SERIES= 2045
CHANNEL 33 SEAT TANGENTIAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

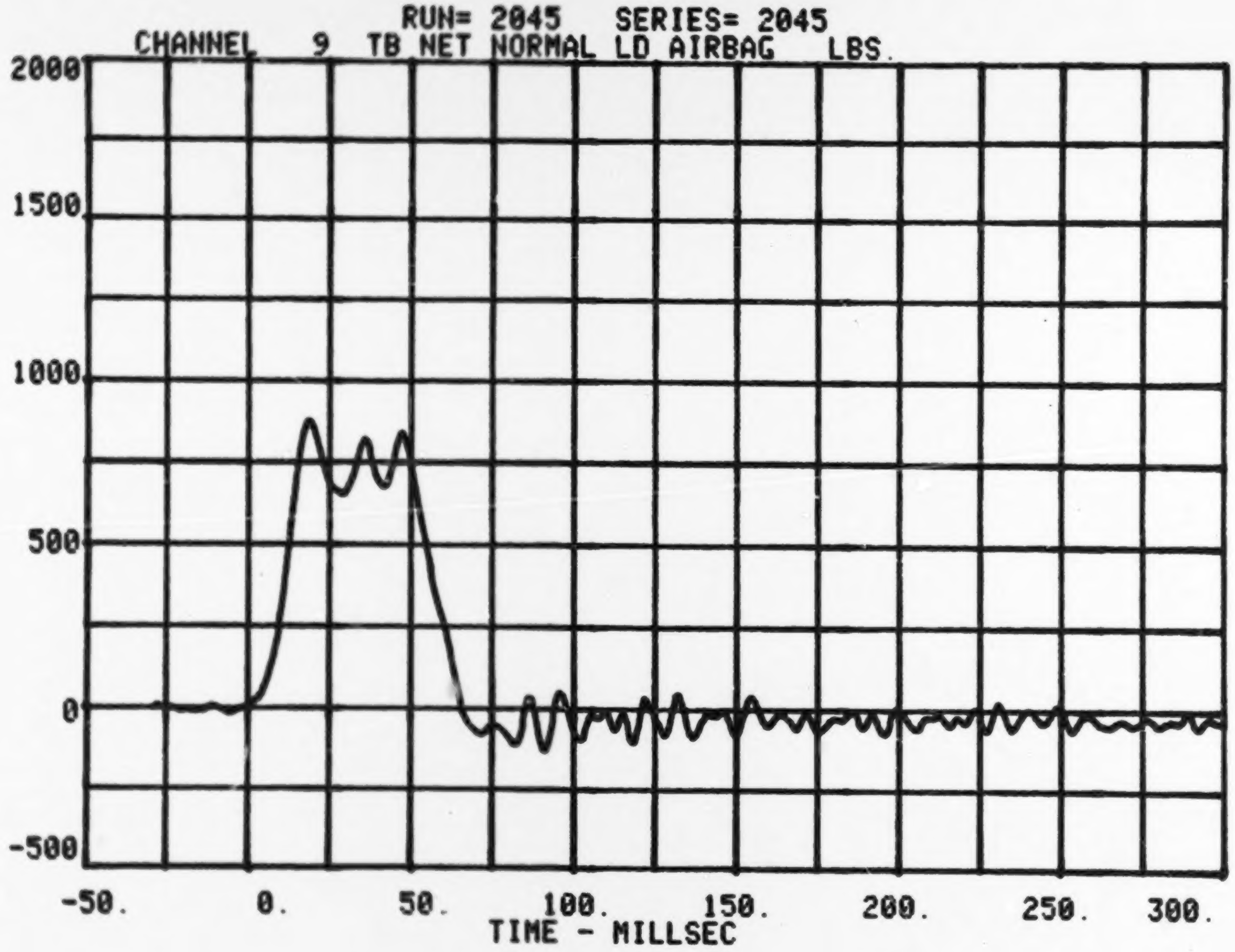

RUN= 2045 SERIES= 2045
CHANNEL 8 SEAT NET TANGL LD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

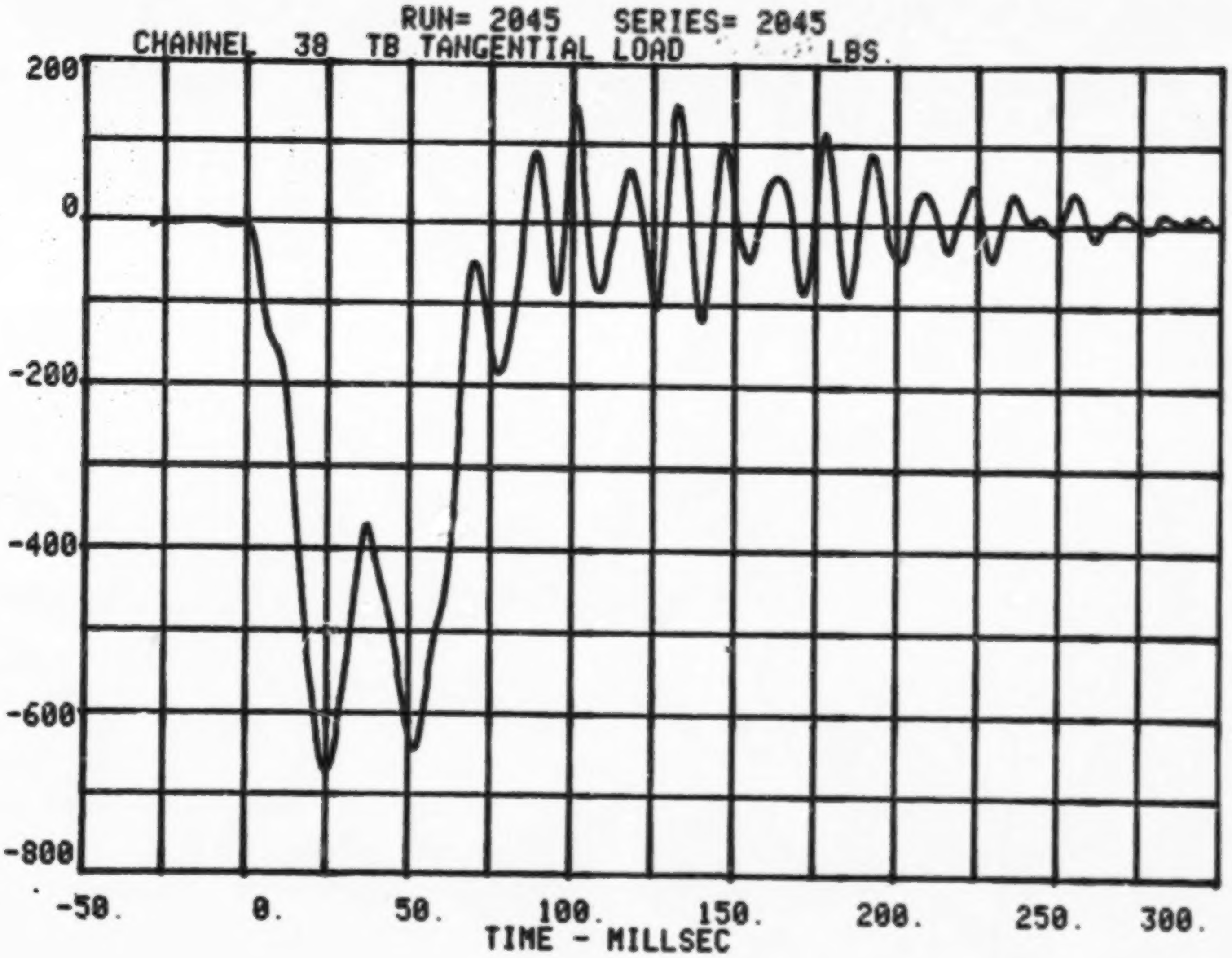

RUN= 2045 SERIES= 2045
CHANNEL 36 TB LOWER LEFT NORMAL LD LBS.
400
300
200
100
0
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2045 SERIES= 2045
CHANNEL 35 TB LOWER RIGHT NORMAL LD LBS.
400
300
200
100
0
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

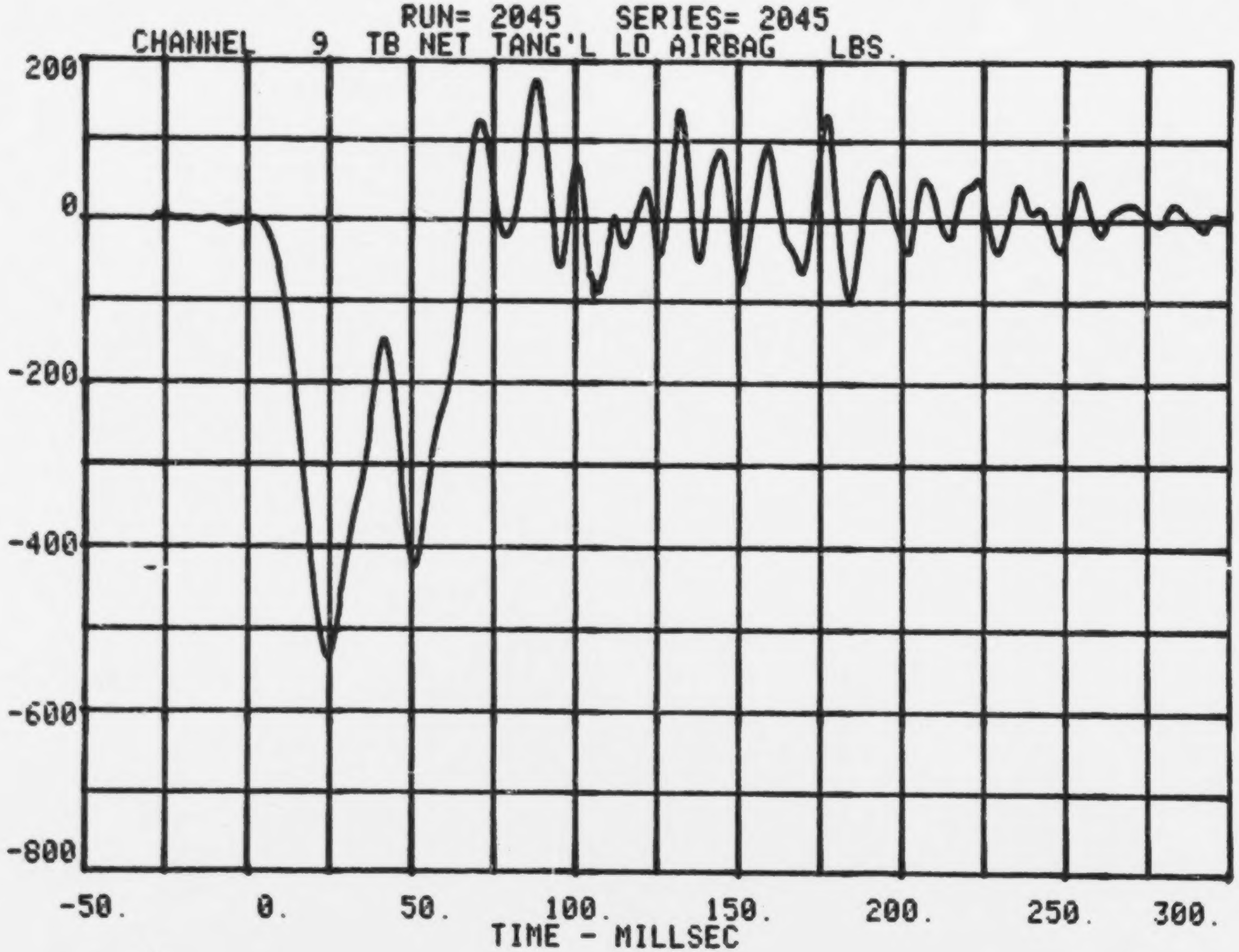

RUN= 2045 SERIES= 2045
CHANNEL 37 TB UPPER CENTER NORM LD LBS.
400
300
200
100
0
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

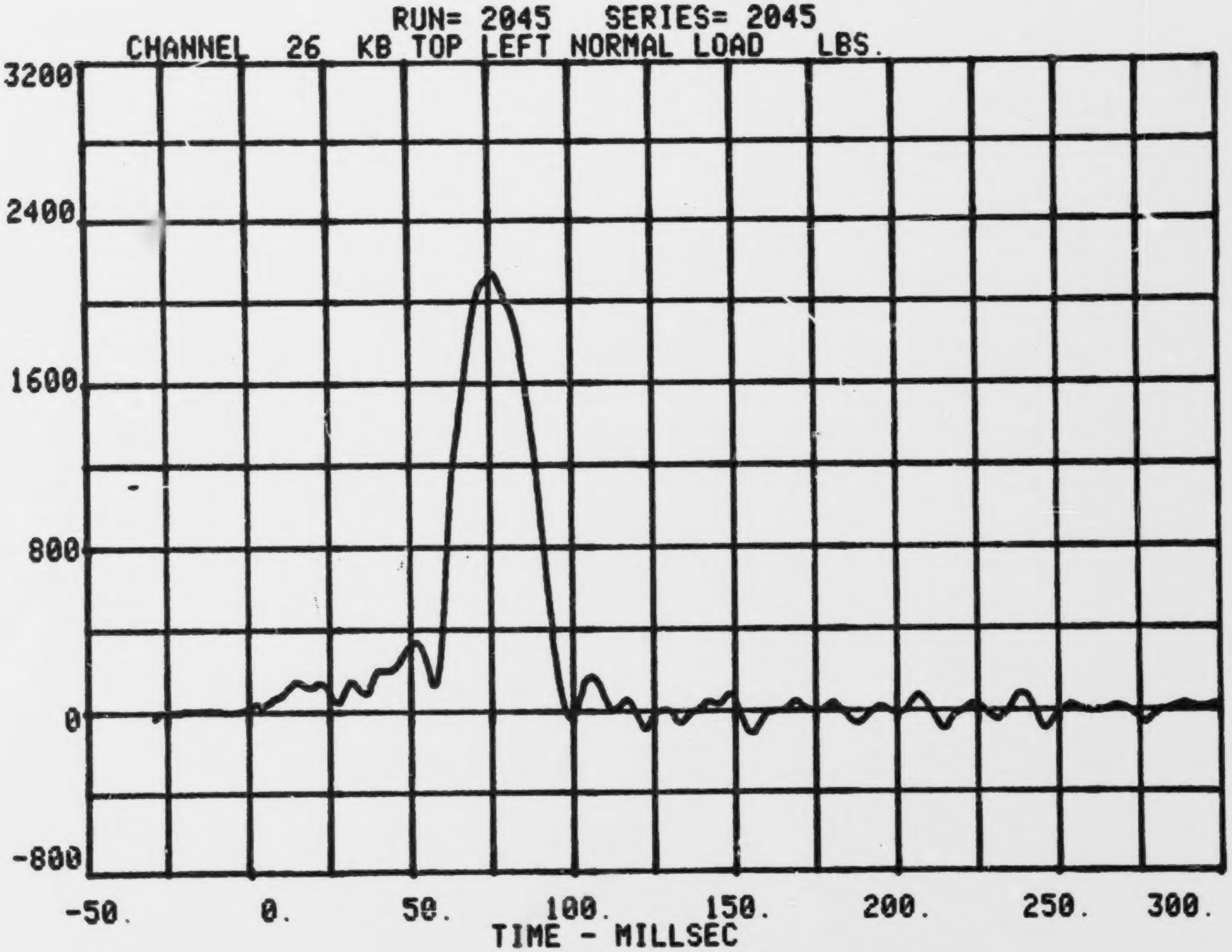

RUN= 2045 SERIES= 2045
CHANNEL 5 TOEBOARD NORMAL LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

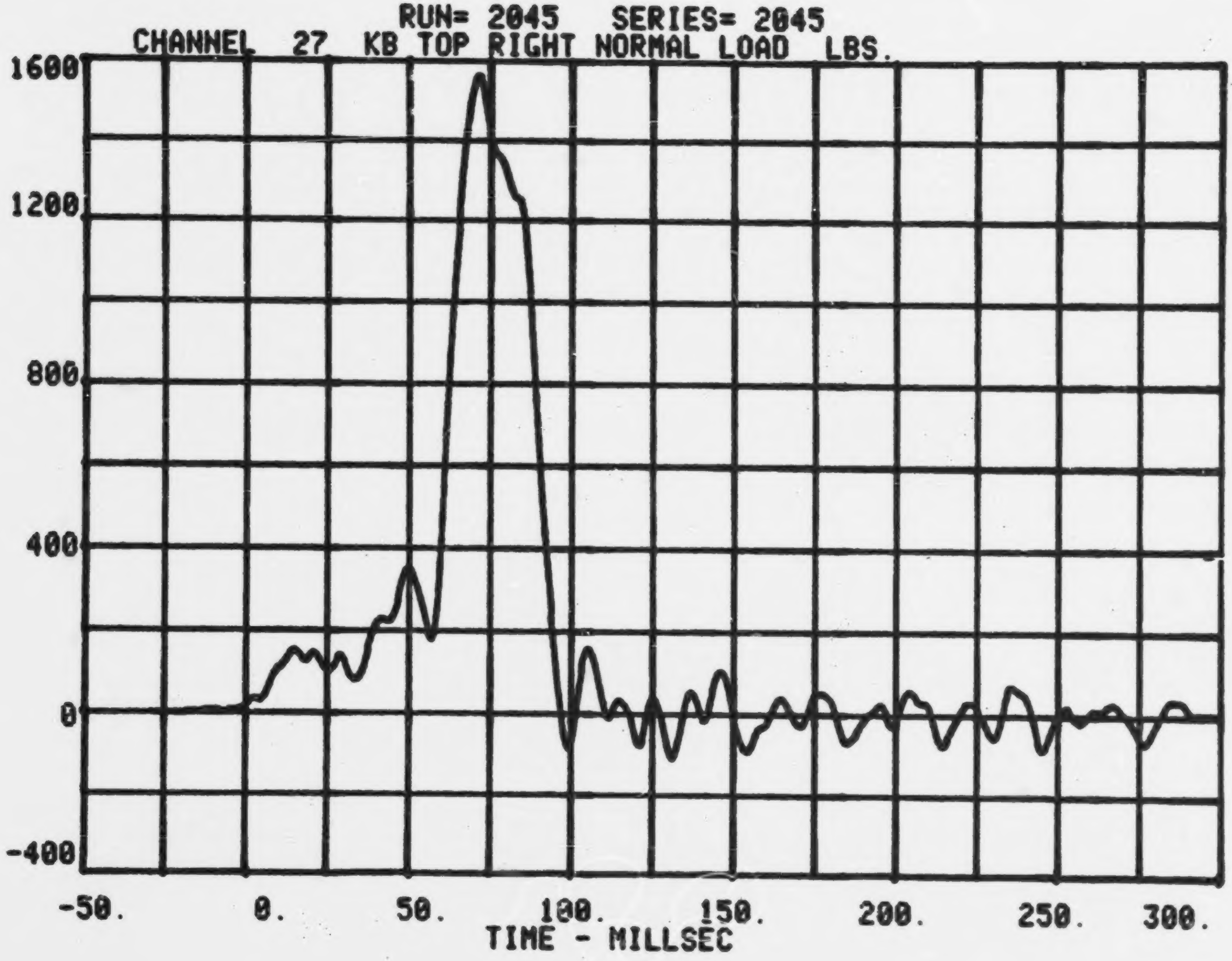

RUN= 2045 SERIES= 2045
CHANNEL 9 TB NET NORMAL LD AIRBAG LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

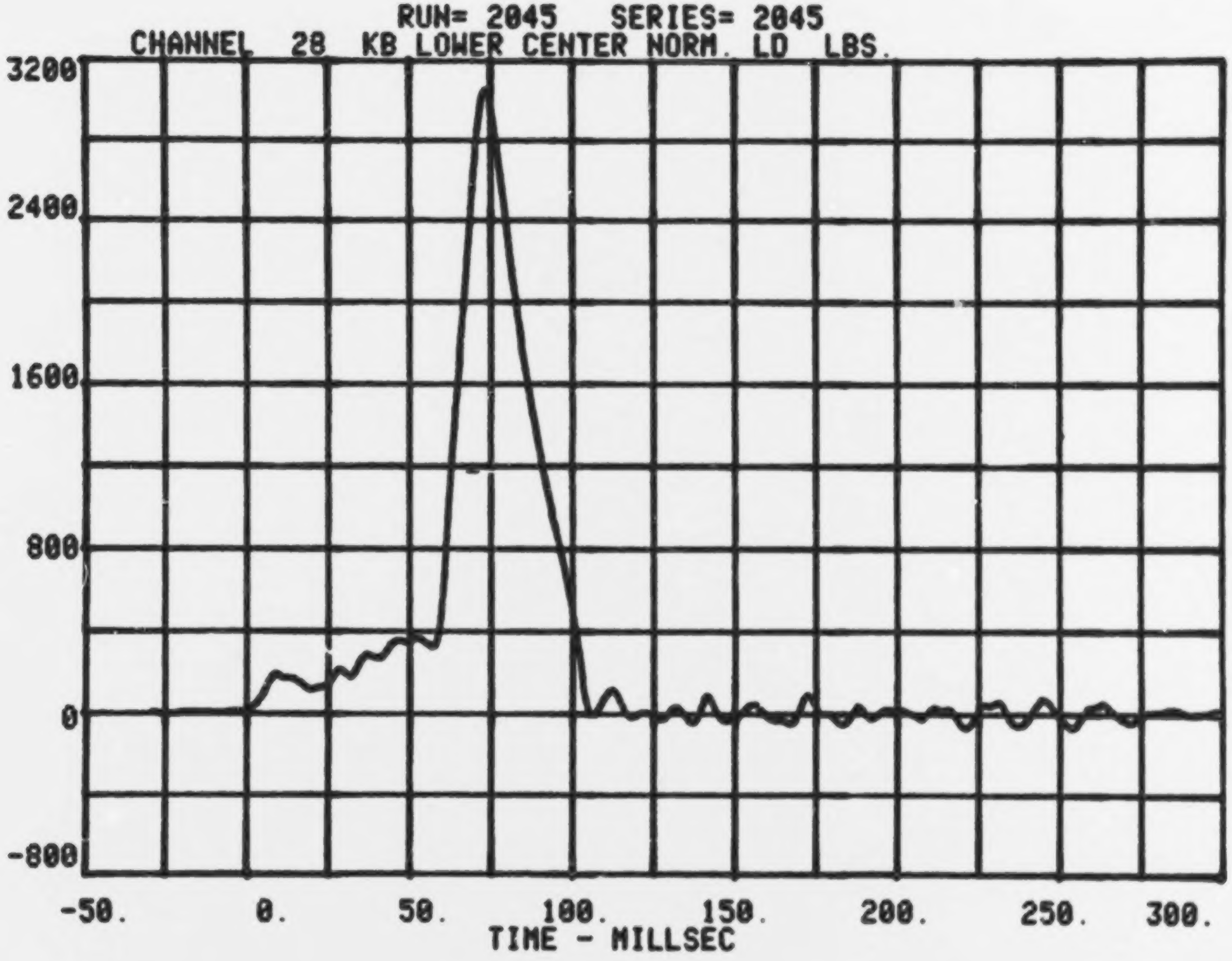


RUN= 2045 SERIES= 2045
CHANNEL 38 TB TANGENTIAL LOAD LBS.

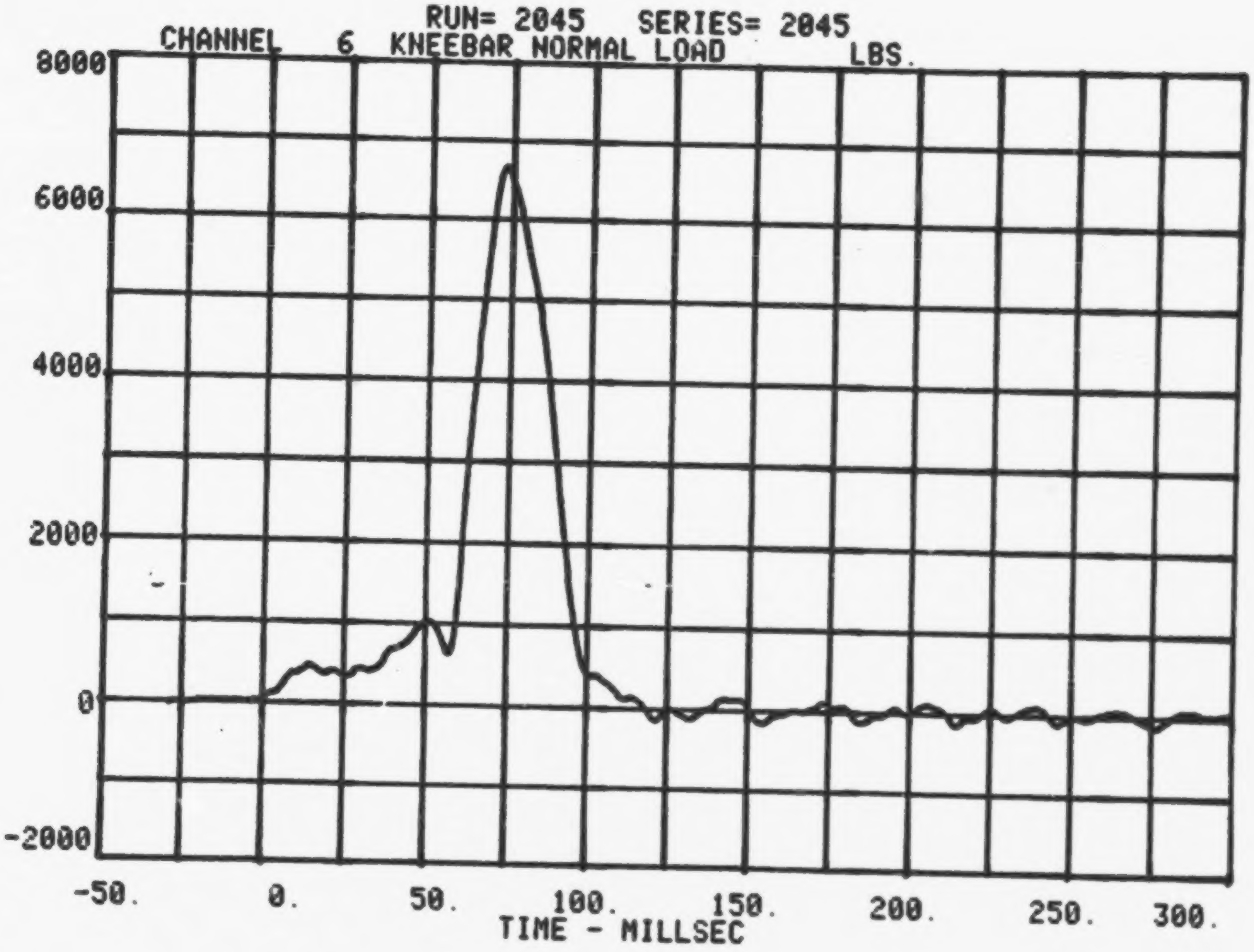

RUN= 2045 SERIES= 2045
CHANNEL 9 TB NET TANG'L LD AIRBAG LBS.
200
0
-200
-400
-600
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2045 SERIES= 2045
CHANNEL 26 KB TOP LEFT NORMAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

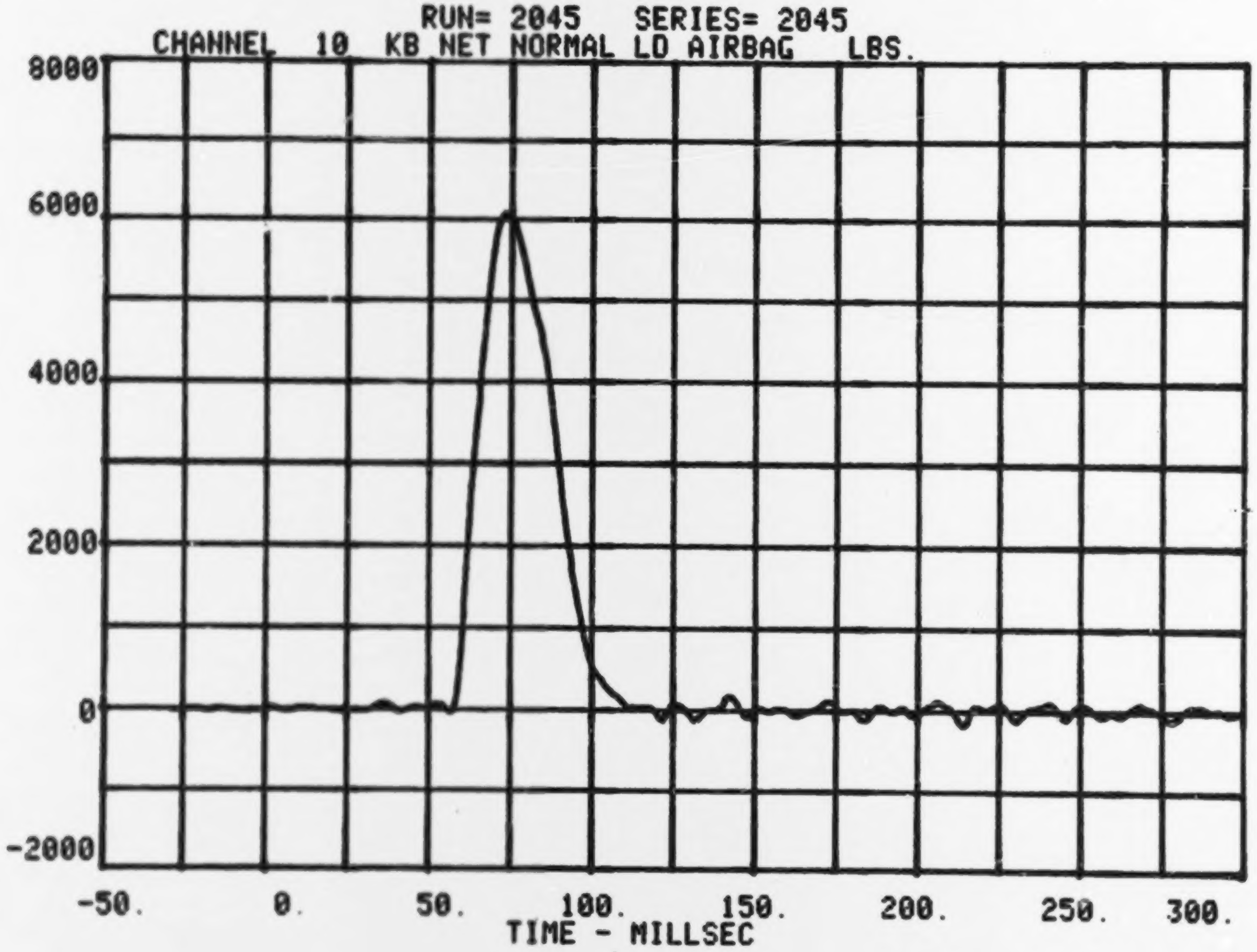

RUN= 2045 SERIES= 2045
CHANNEL 27 KB TOP RIGHT NORMAL LOAD LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



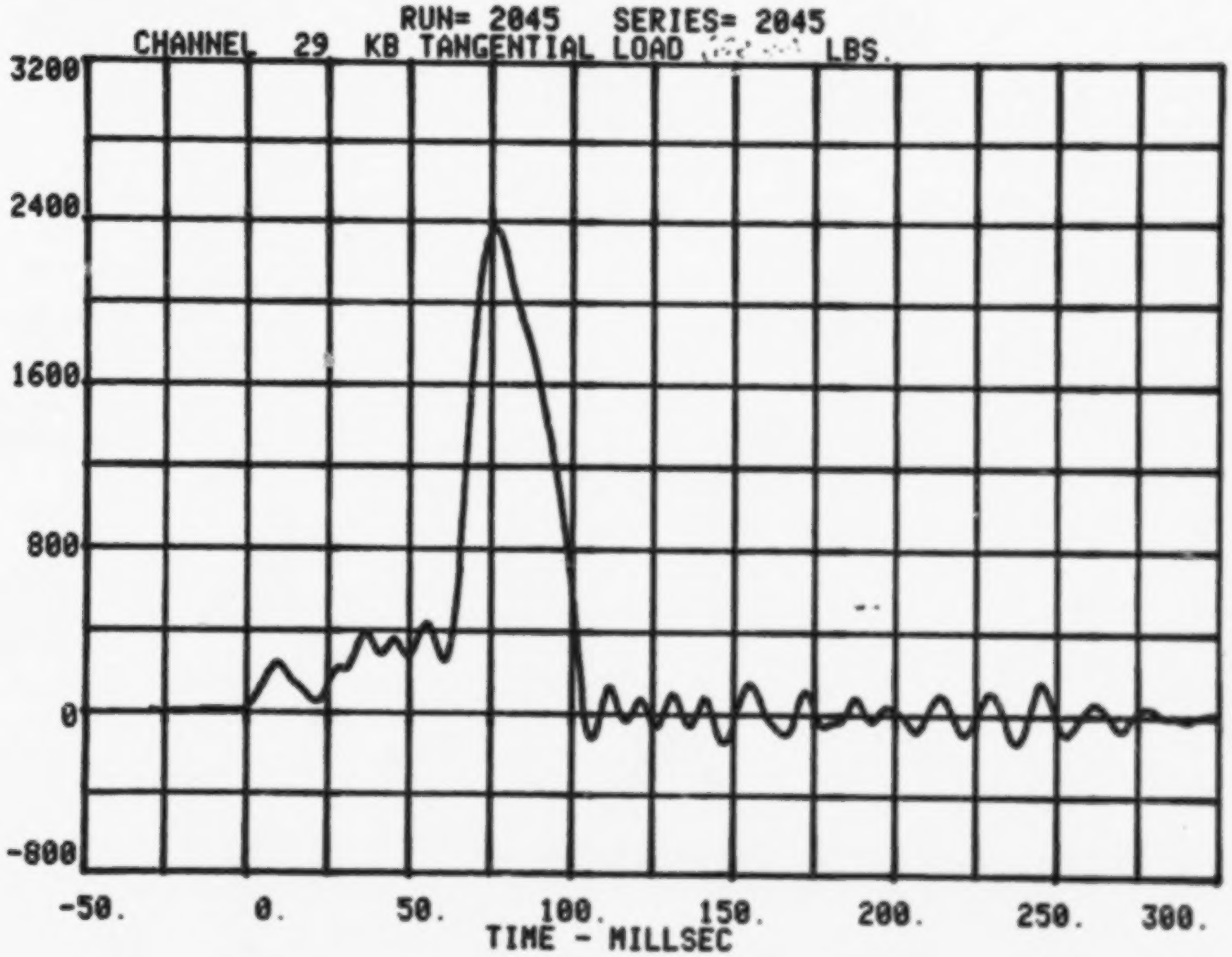
BEST DOCUMENT AVAILABLE

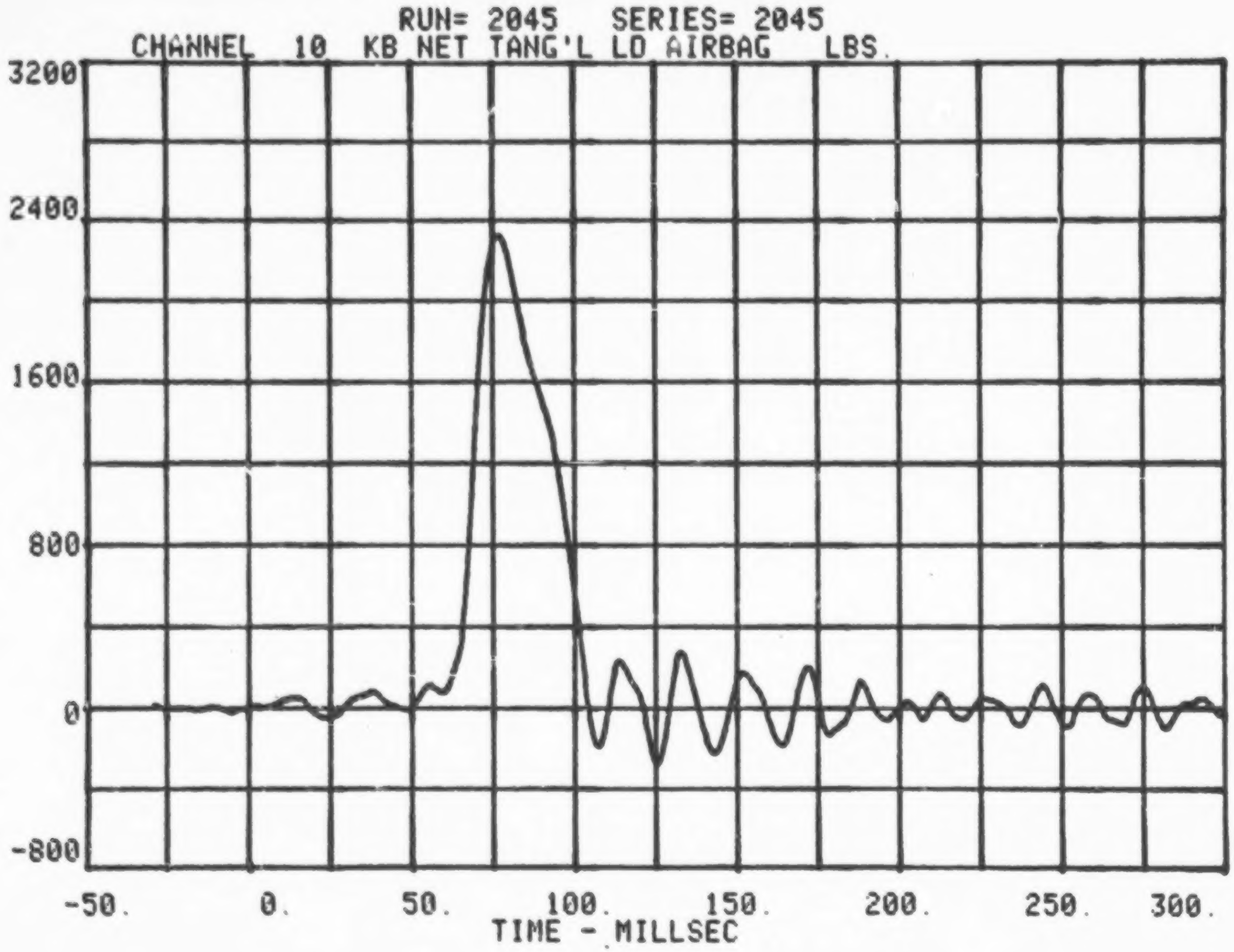


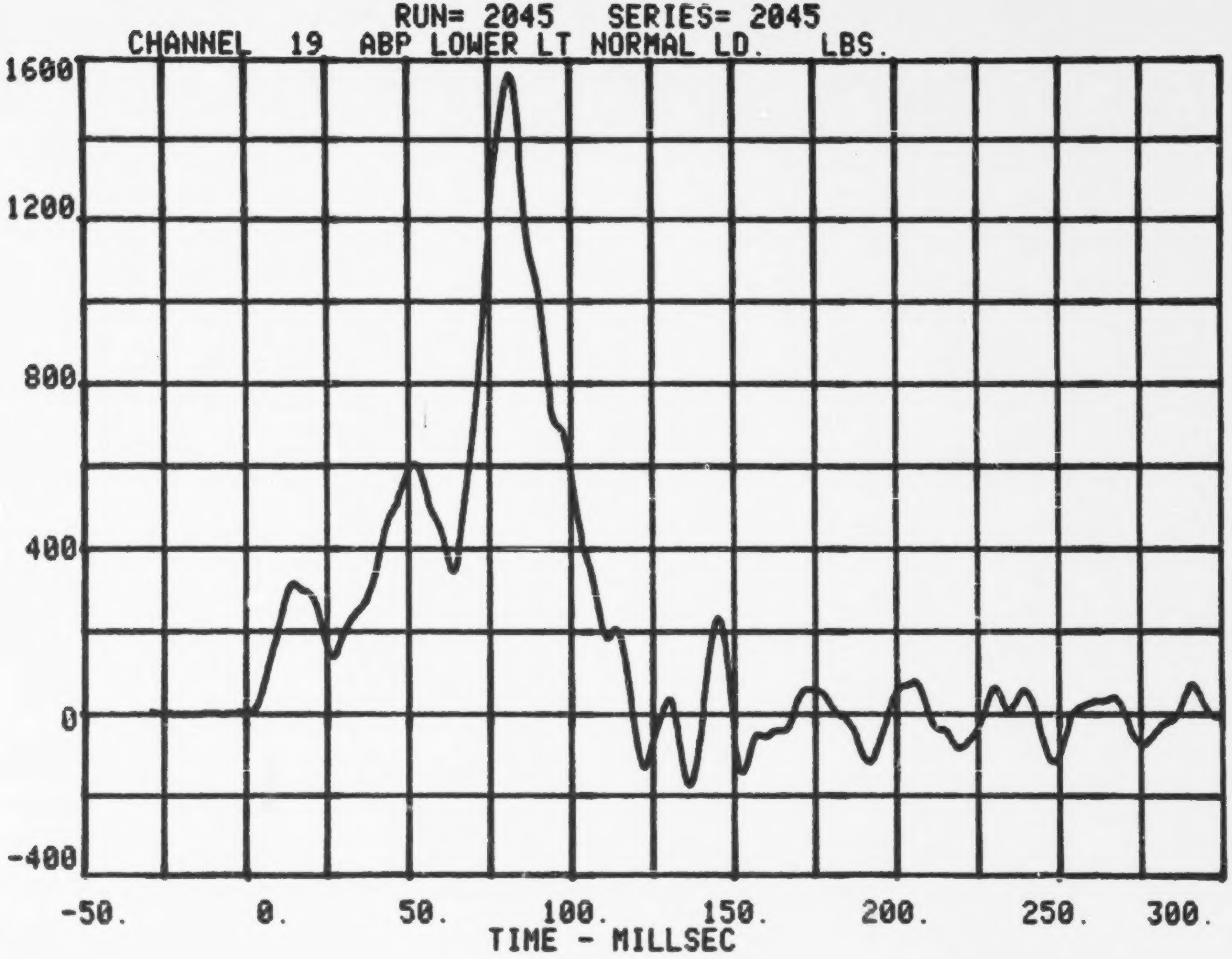
BEST DOCUMENT AVAILABLE



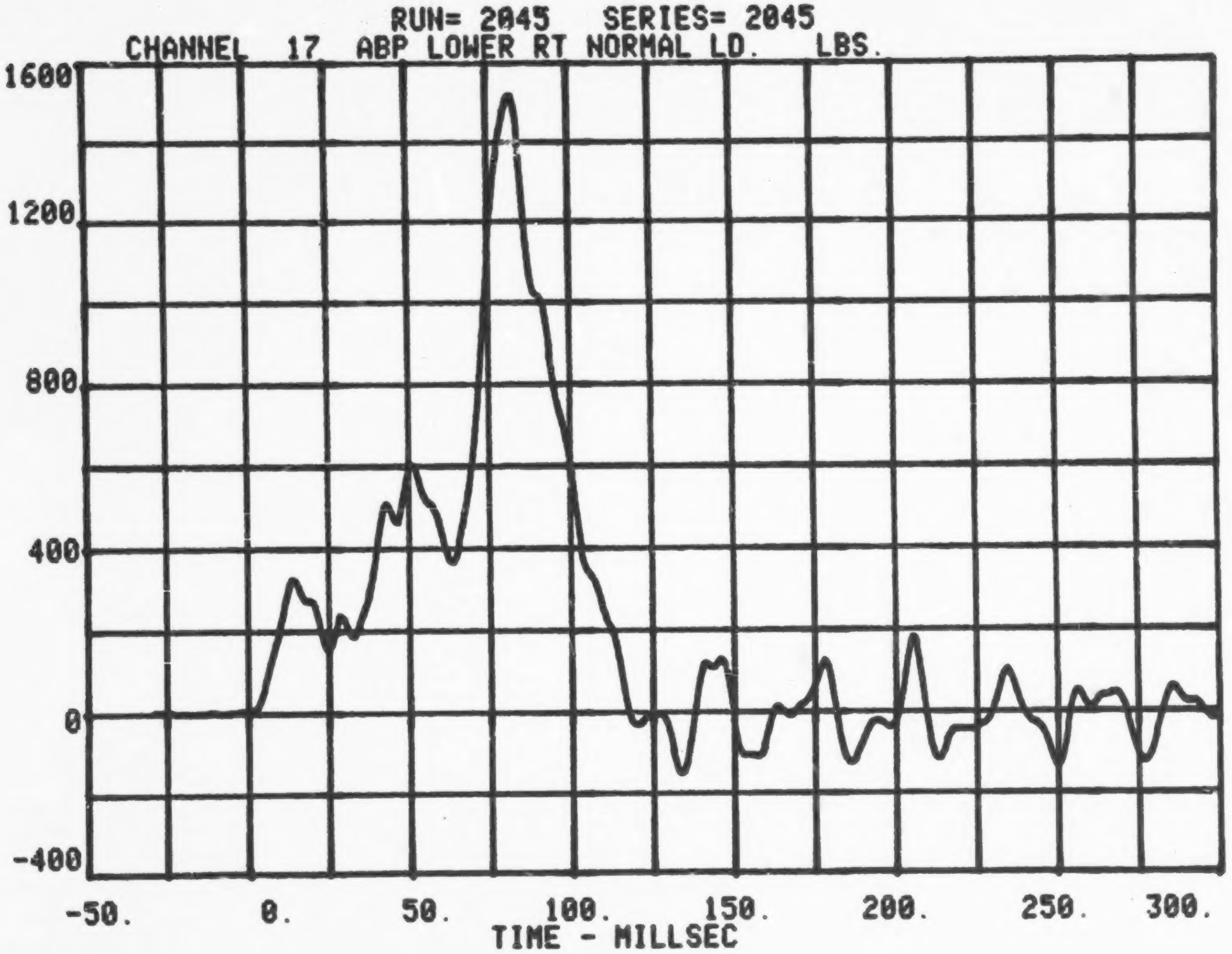
BEST DOCUMENT AVAILABLE


RUN= 2045 SERIES= 2045
CHANNEL 29 KB TANGENTIAL LOAD [illegible] LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

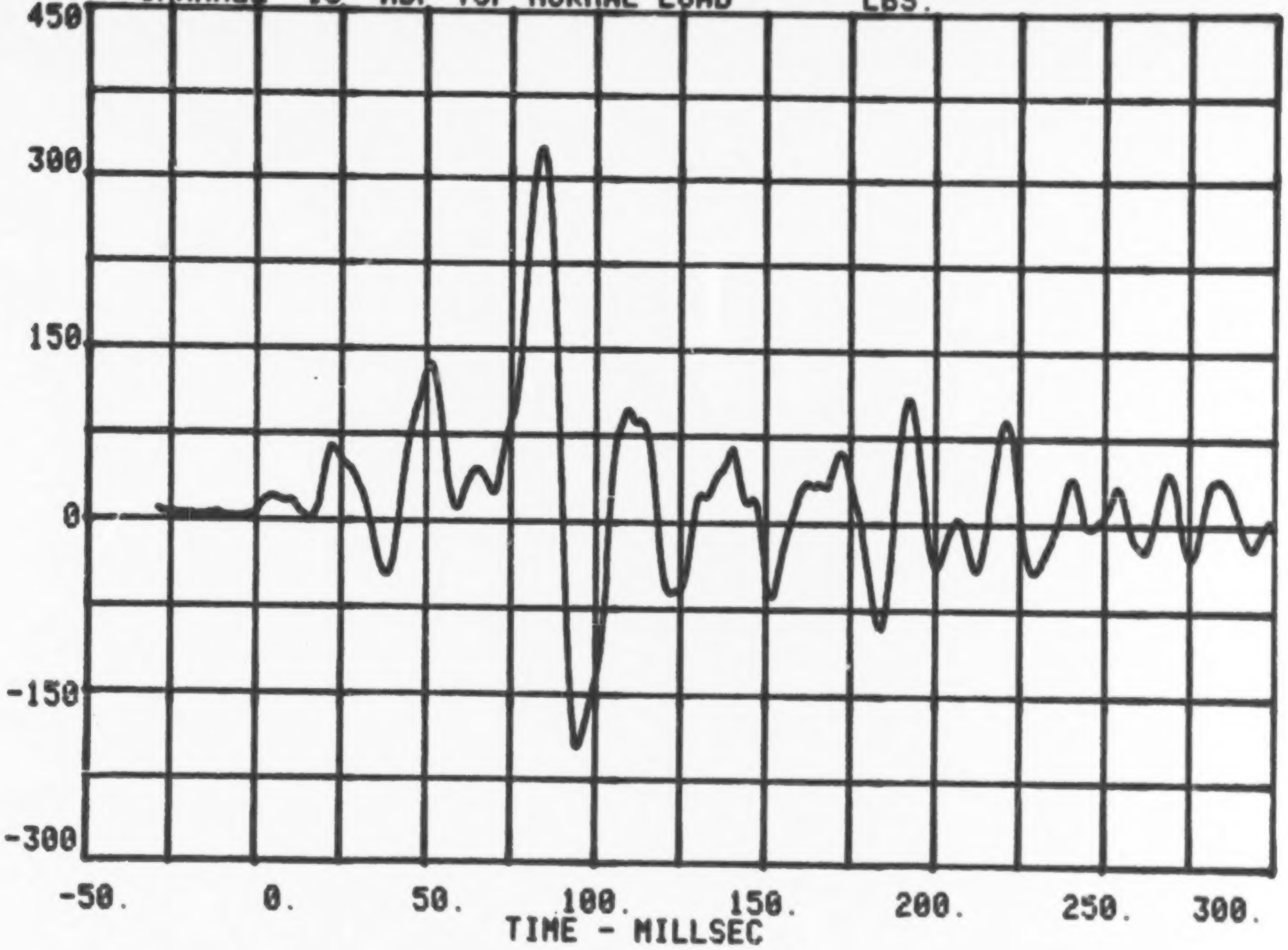
 RUN= 2045 SERIES= 2045
CHANNEL 10 KB NET TANG'L LD AIRBAG LBS.



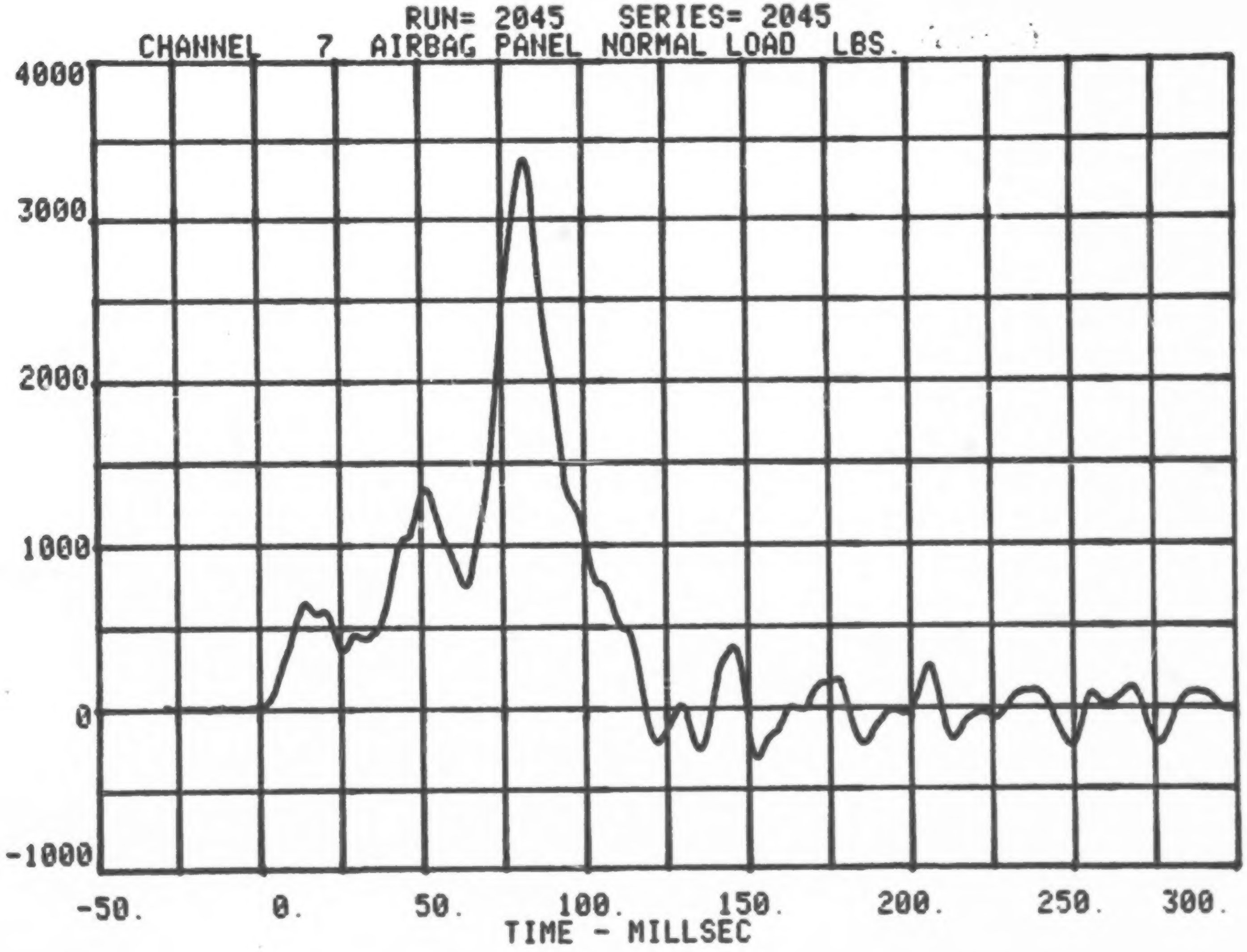
BEST DOCUMENT AVAILABLE



BEST DOCUMENT AVAILABLE

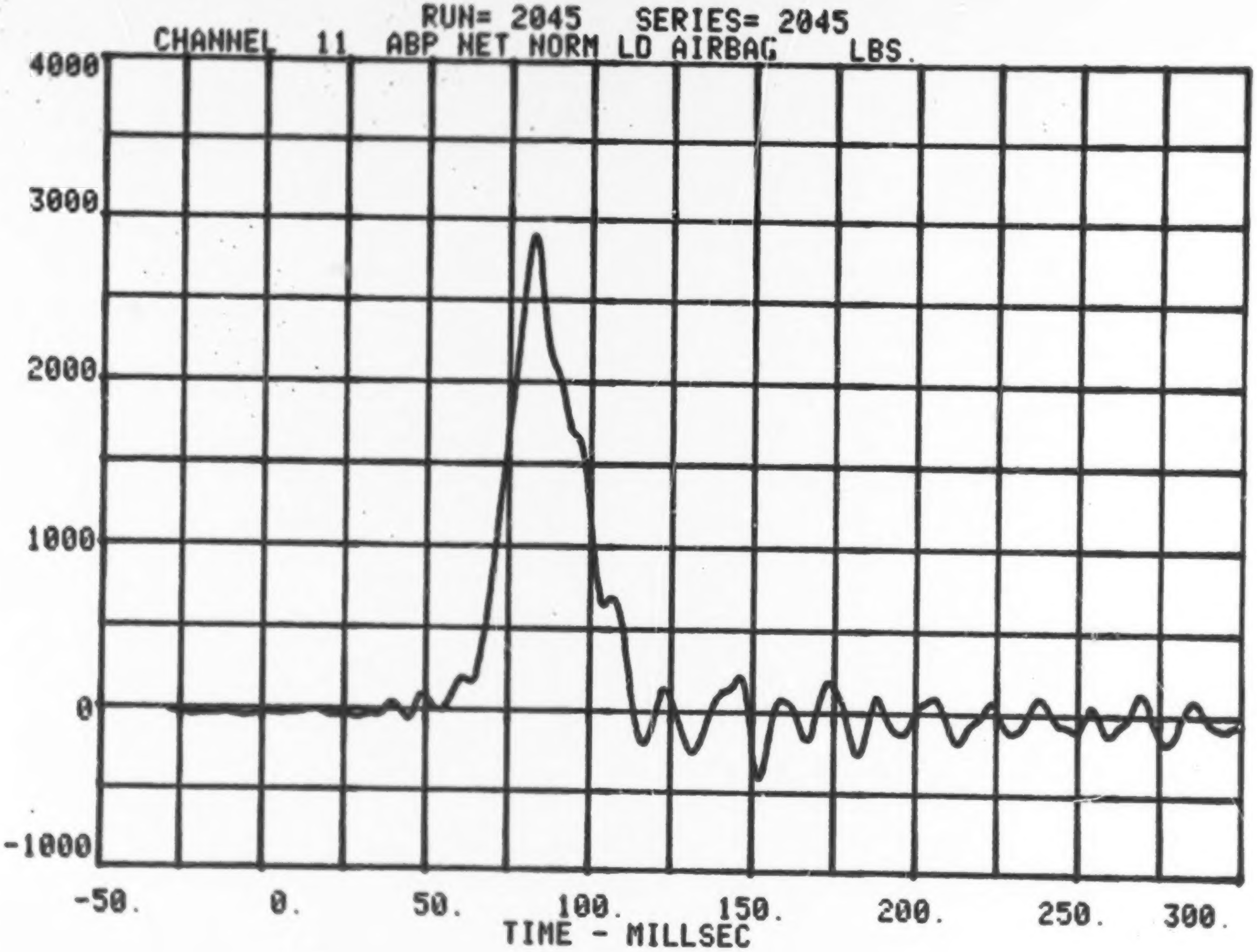


RUN= 2045 SERIES= 2045
CHANNEL 18 ABP TOP NORMAL LOAD LBS.



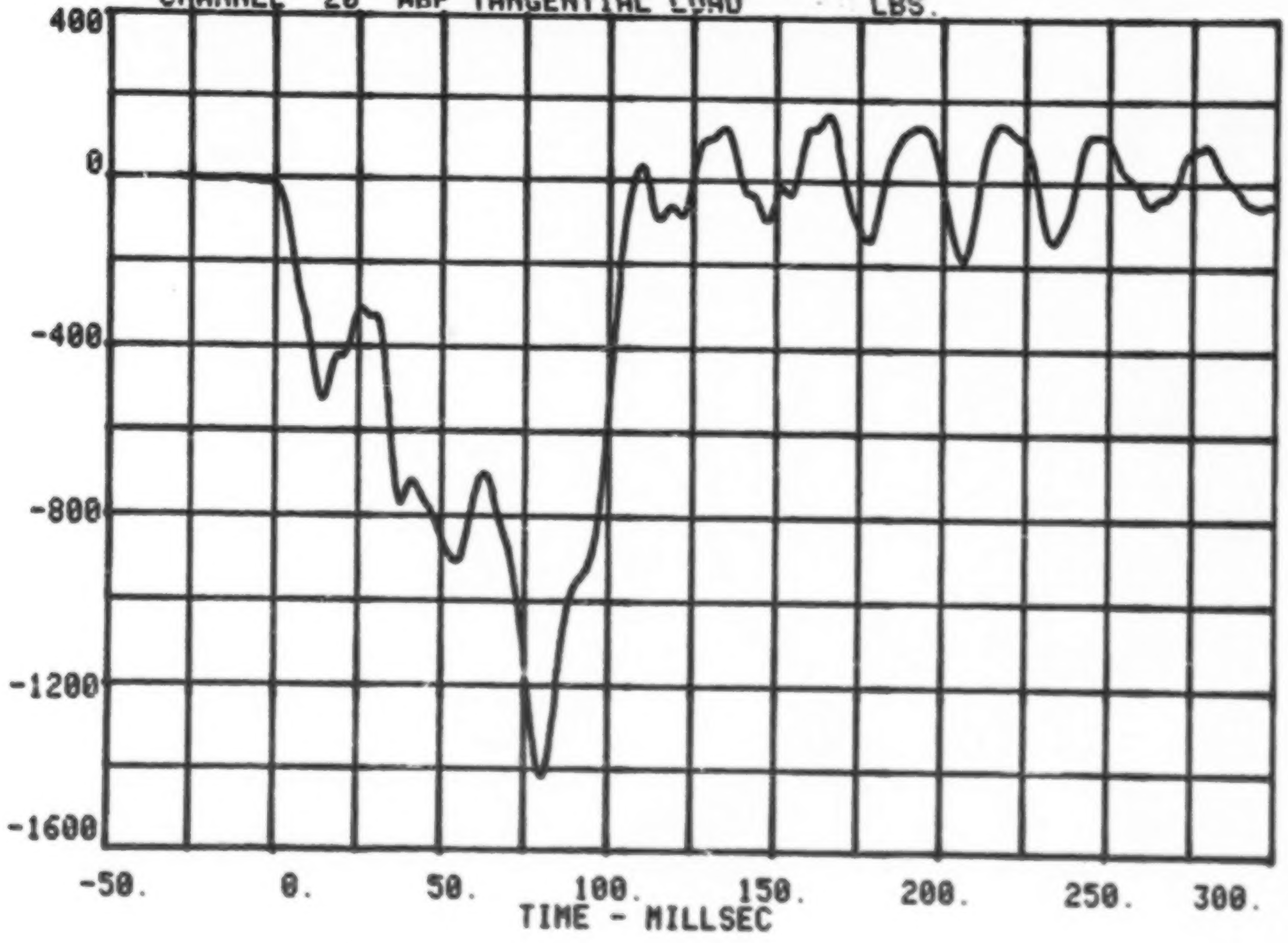
RUN= 2045 SERIES= 2045

CHANNEL 7 AIRBAG PANEL NORMAL LOAD LBS.

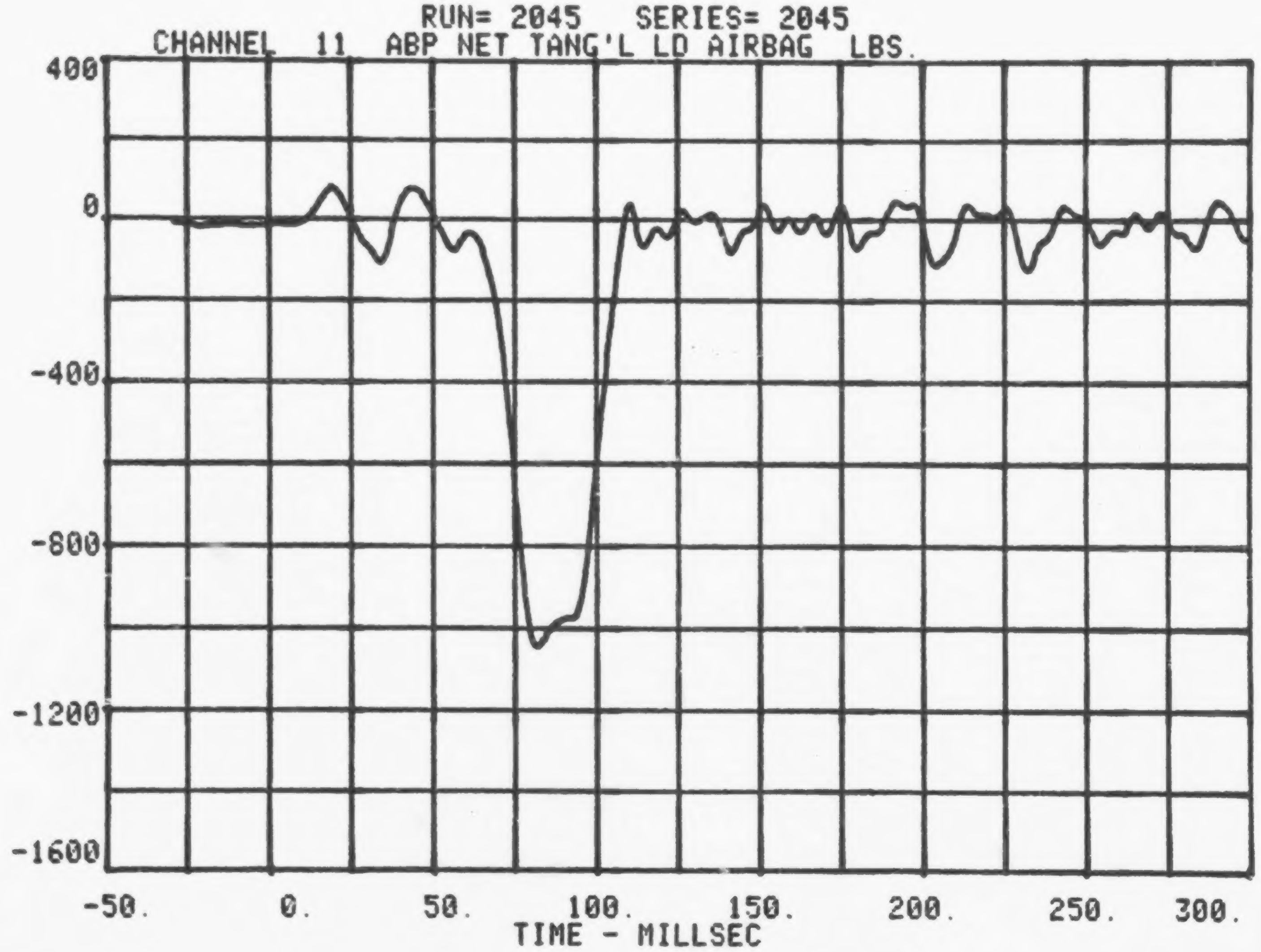


BEST DOCUMENT AVAILABLE

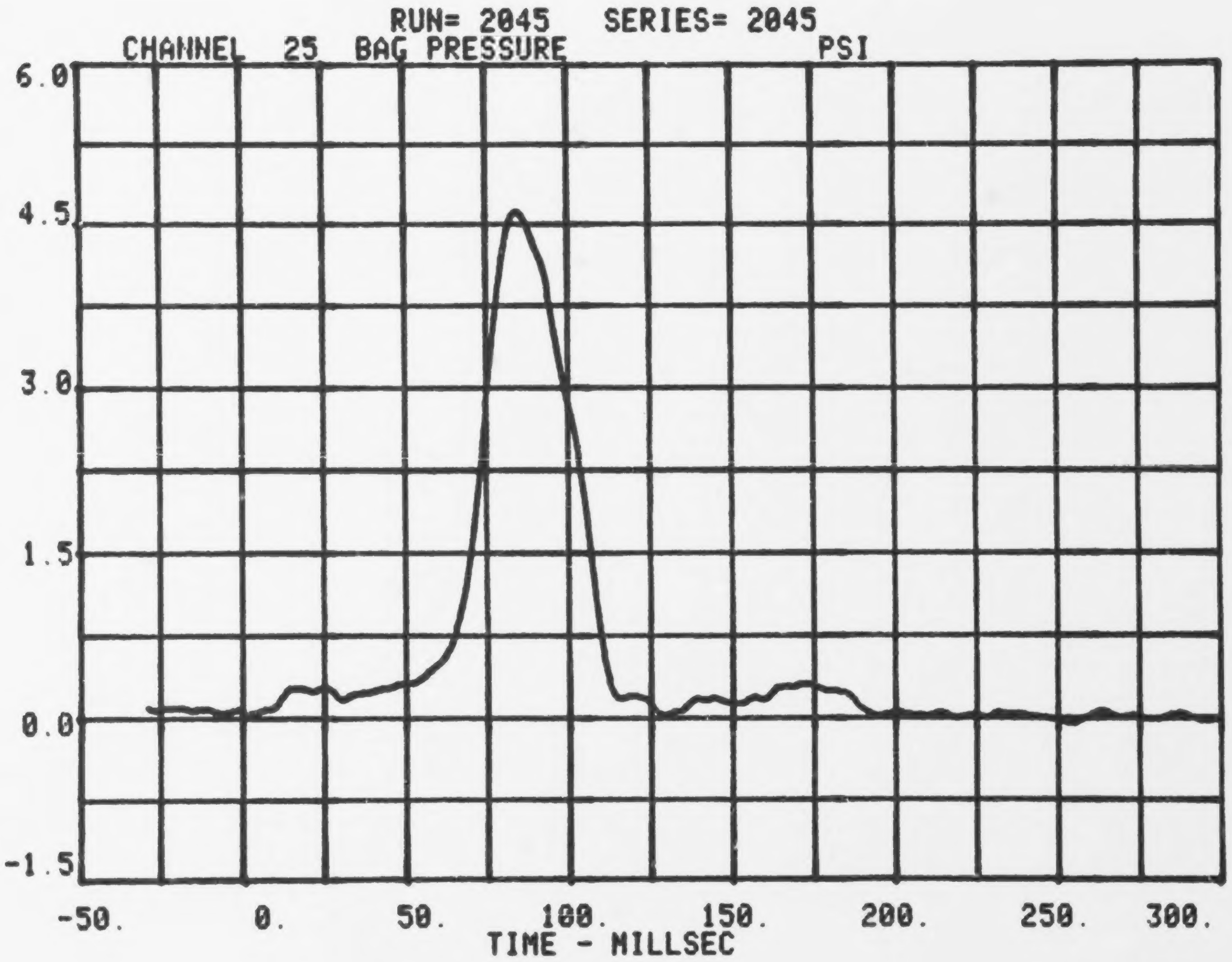
RUN= 2045 SERIES= 2045
CHANNEL 20 ABP TANGENTIAL LOAD LBS.



BEST DOCUMENT AVAILABLE



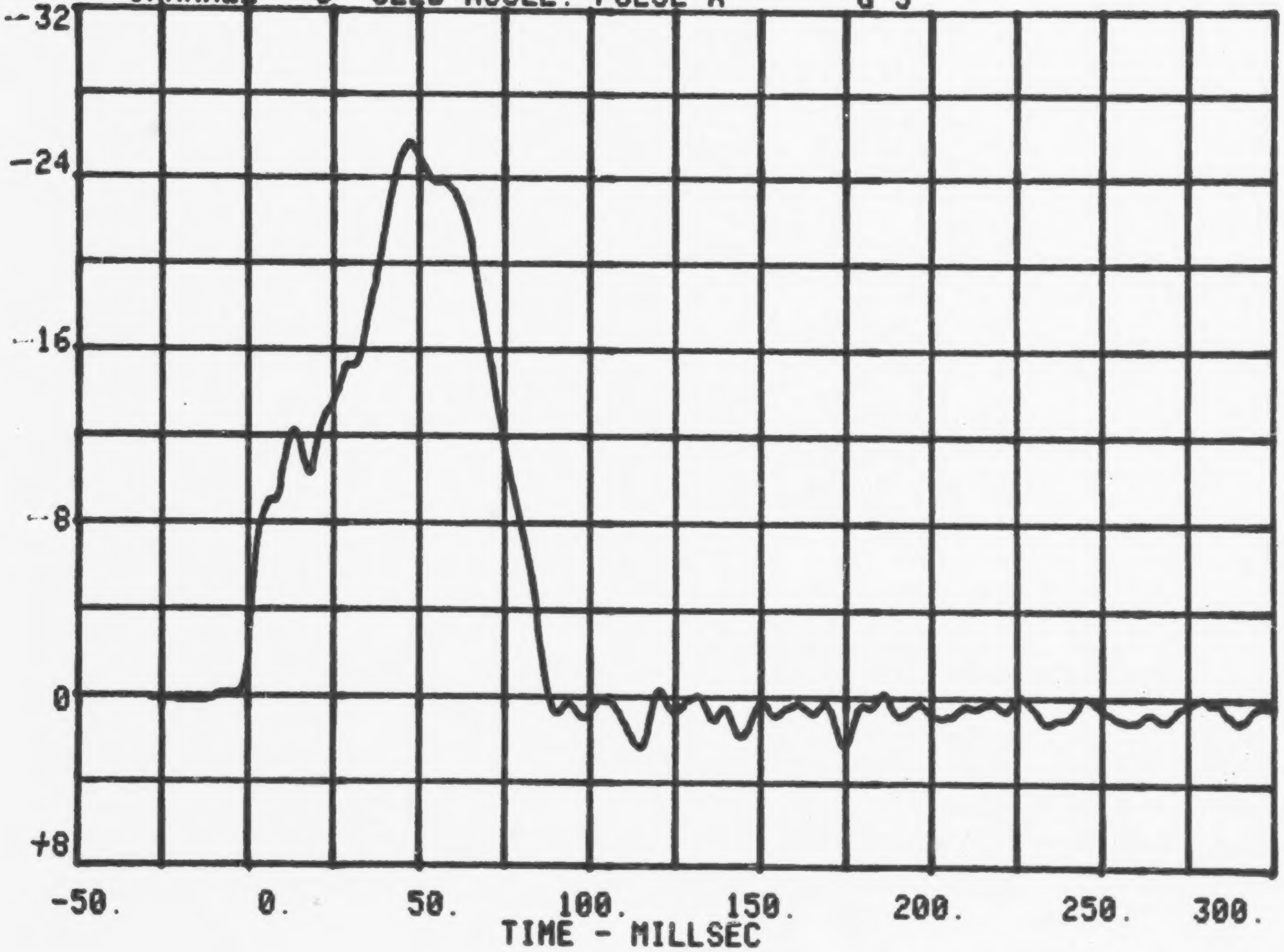
BEST DOCUMENT AVAILABLE


RUN= 2045 SERIES= 2045

CHANNEL 25 BAG PRESSURE PSI

RUN= 2045 SERIES= 2045

CHANNEL 8 SLED ACCEL. PULSE X G'S



BEST DOCUMENT AVAILABLE

APPENDIX E

AIR BAG RESTRAINT SLED TEST 2046 DATA RECORDS

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Pelvis Accelerations	180
Femur Loads	600
Contact Panel Loads	60
Bag Pressure	60
Sled Acceleration	60

Sequence of Data Records

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Pelvis - X, Y, Z, Resultant Accelerations

Femur Load - Left, Right

Seat Normal Load - Front Left, Front Right, Rear, Gross Sum, Net Sum

Seat Tangential Load - Gross, Net

Toeboard Normal Load - Lower Left, Lower Right, Upper Center, Gross Sum, Net Sum

Toeboard Tangential Load - Gross, Net

Knee Bolster Normal Load - Top Left, Top Right, Lower Center, Gross Sum, Net Sum

Knee Bolster Tangential Load - Gross, Net

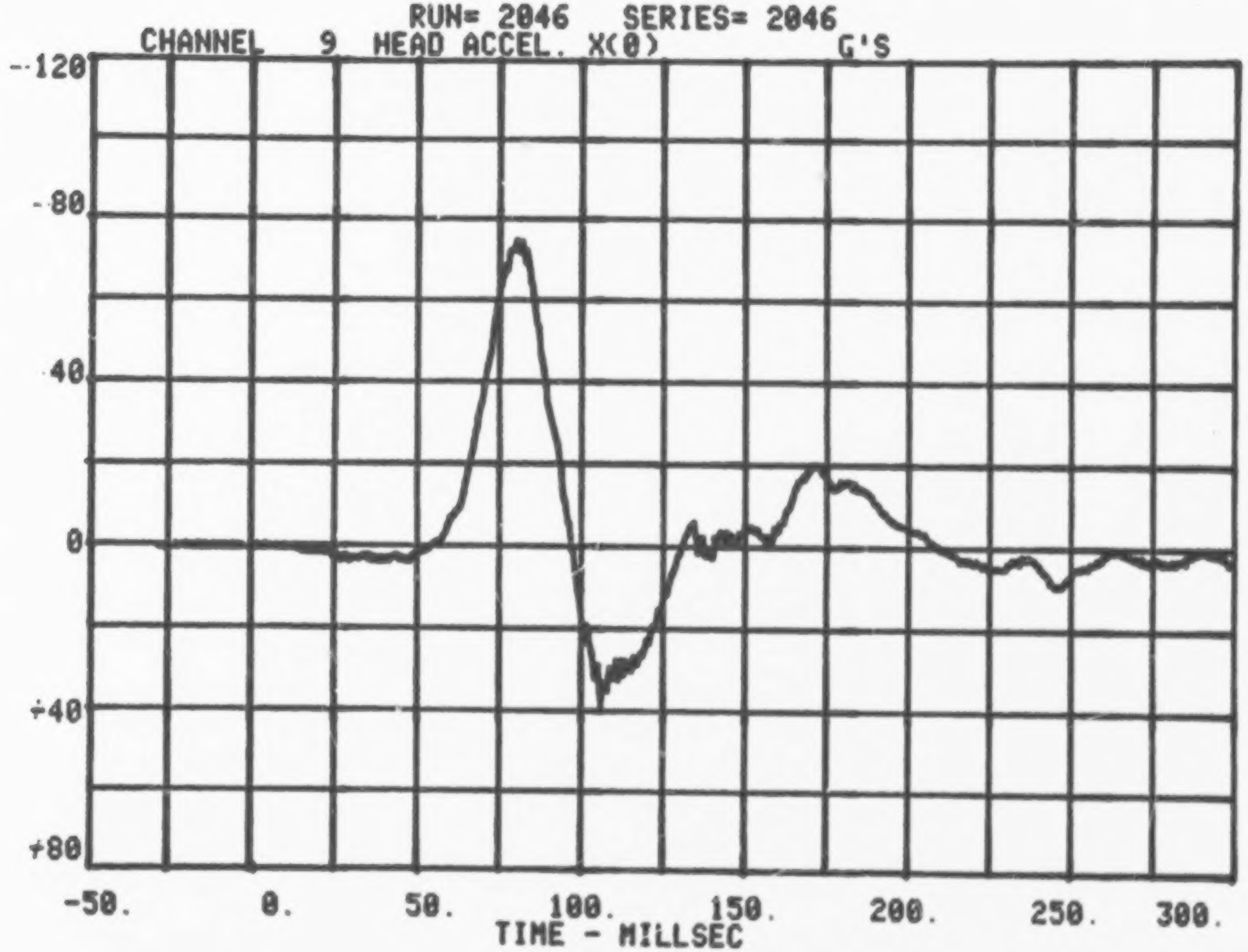
Air Bag Panel Normal Load - Lower Left, Lower Right, Top, Gross Sum, Net Sum

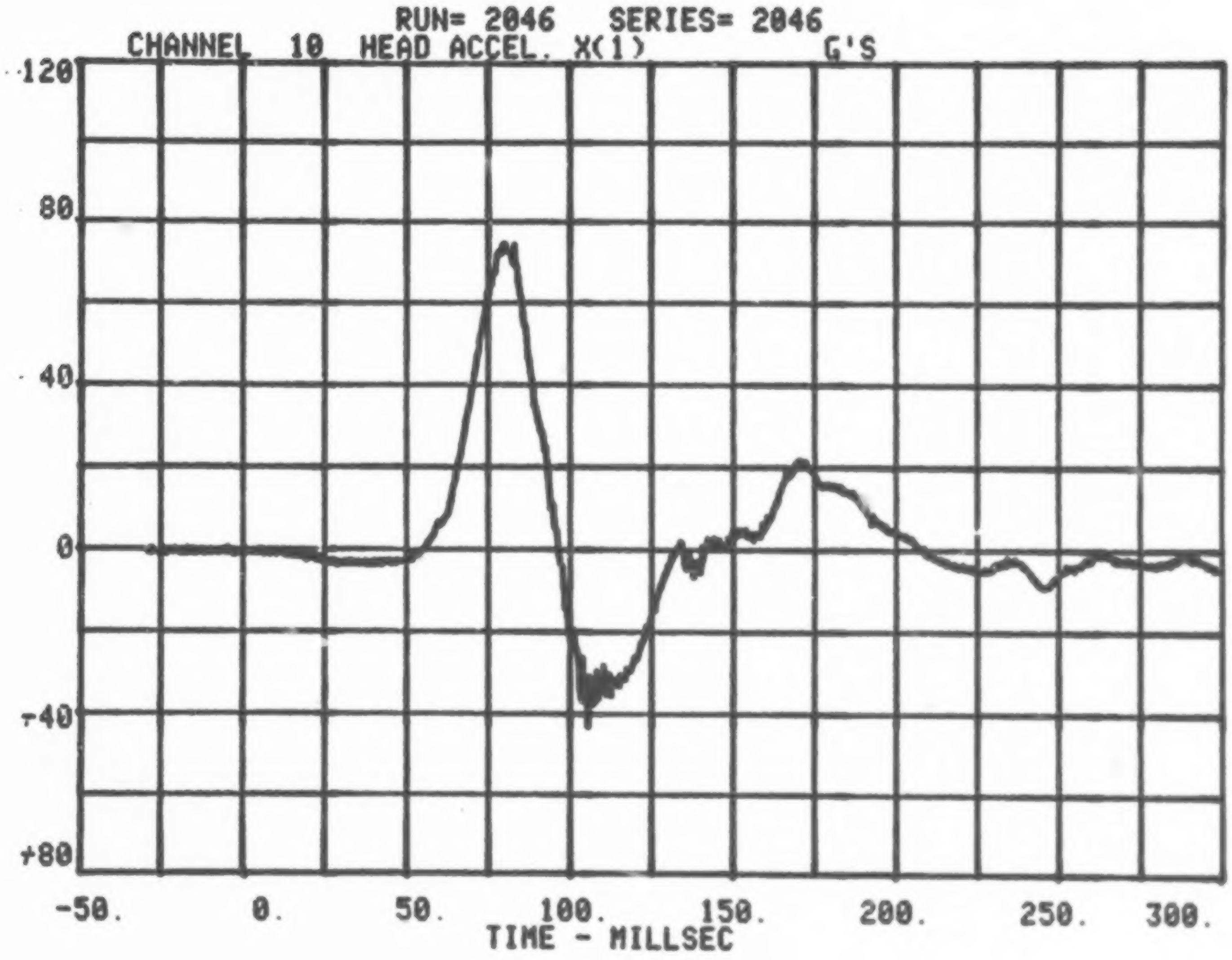
Air Bag Panel Tangential Load - Gross, Net

Air Bag Pressure

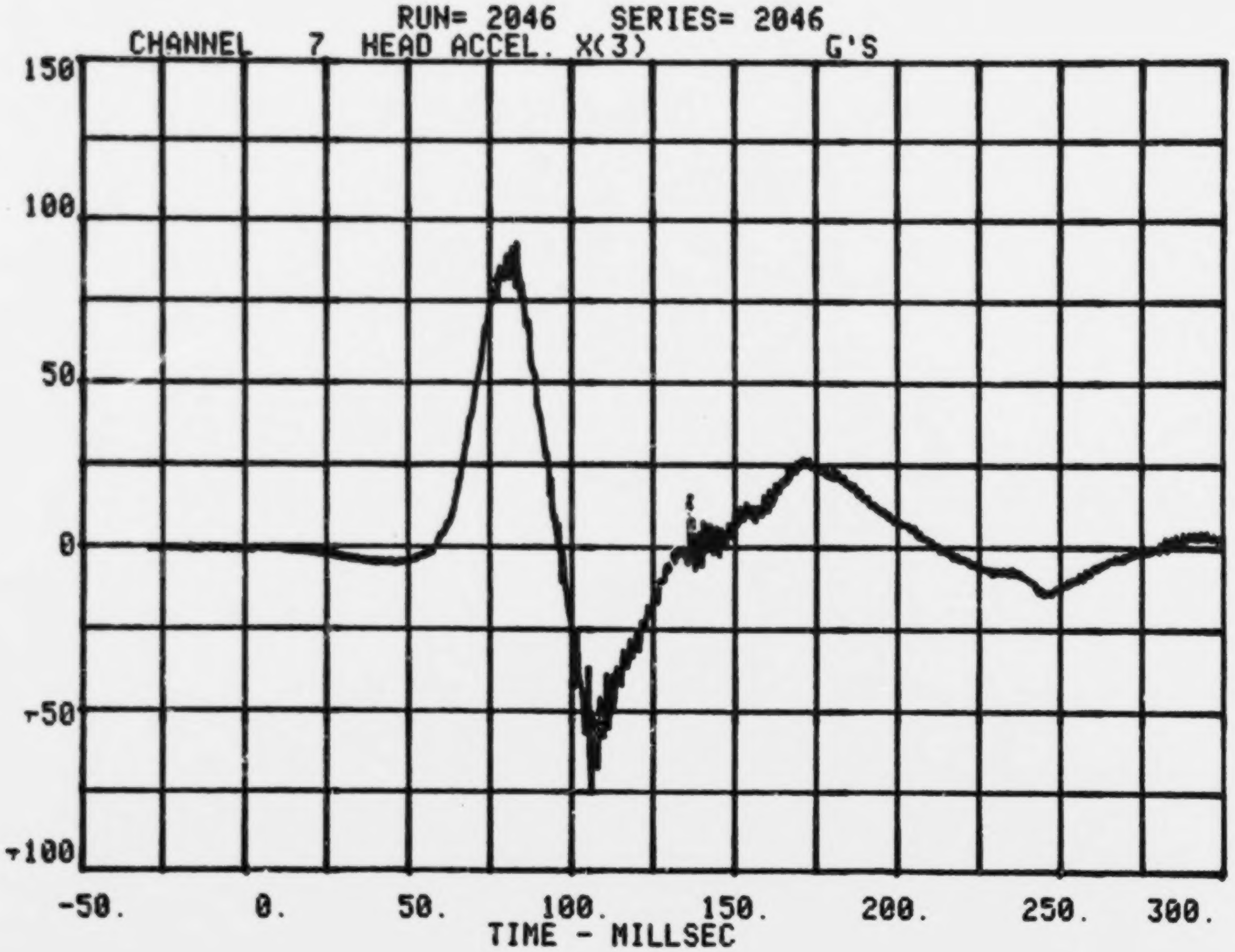
Sled Acceleration

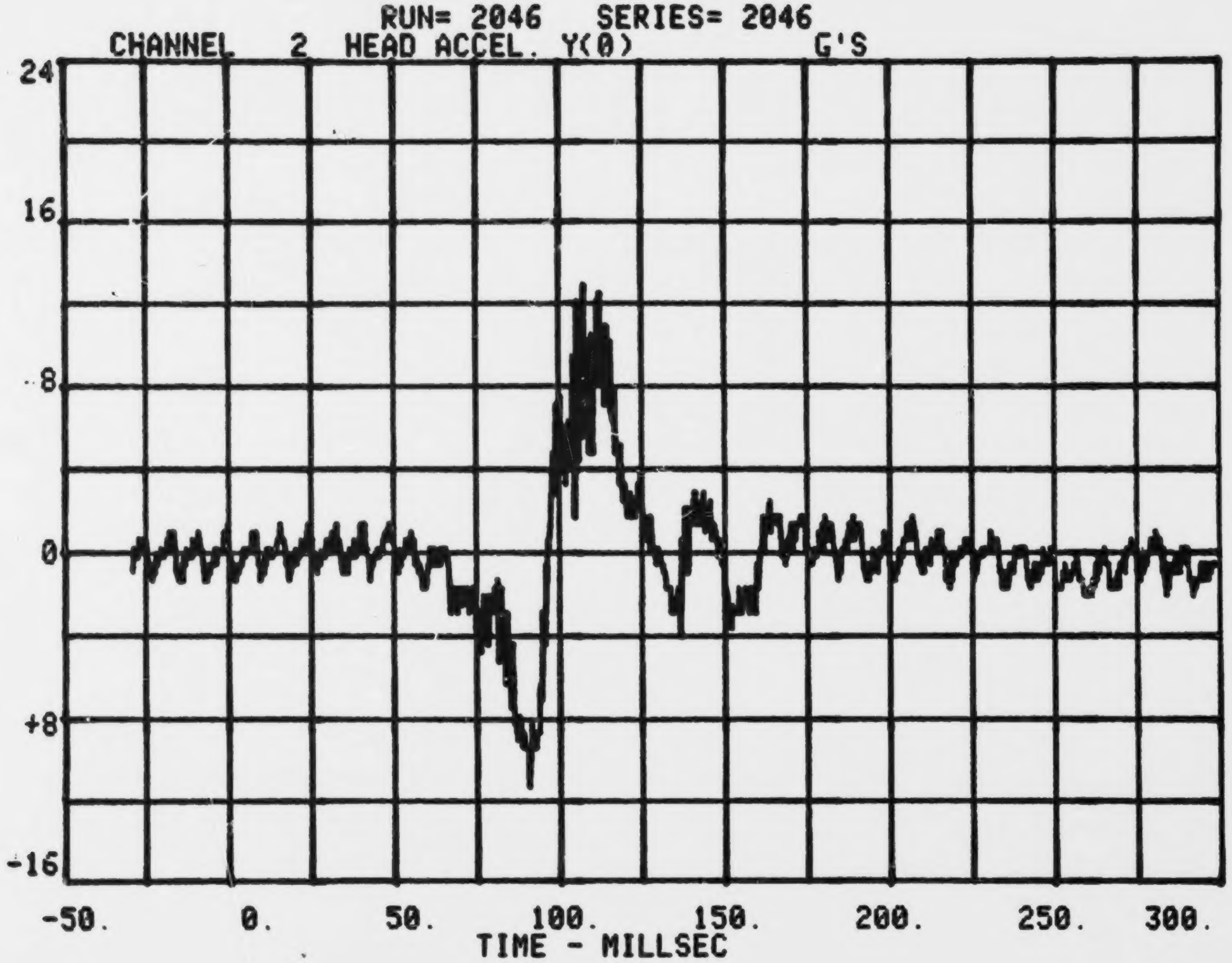
```
                         HEAD INJURY CRITERION
                          HEAD SEVERITY INDEX

               SLED TEST #2046

               RUN=2046

               RESULT. HEAD ACCEL.

       HIC=1108.8   FROM T1= .06870   TO T2= .11610

       AVERAGE ACCELERATION BETWEEN T1 AND T2=  55.9G'S

       EVENT TIME= 300.0  MSEC

       SEVERITY INDEX=1552.6
```

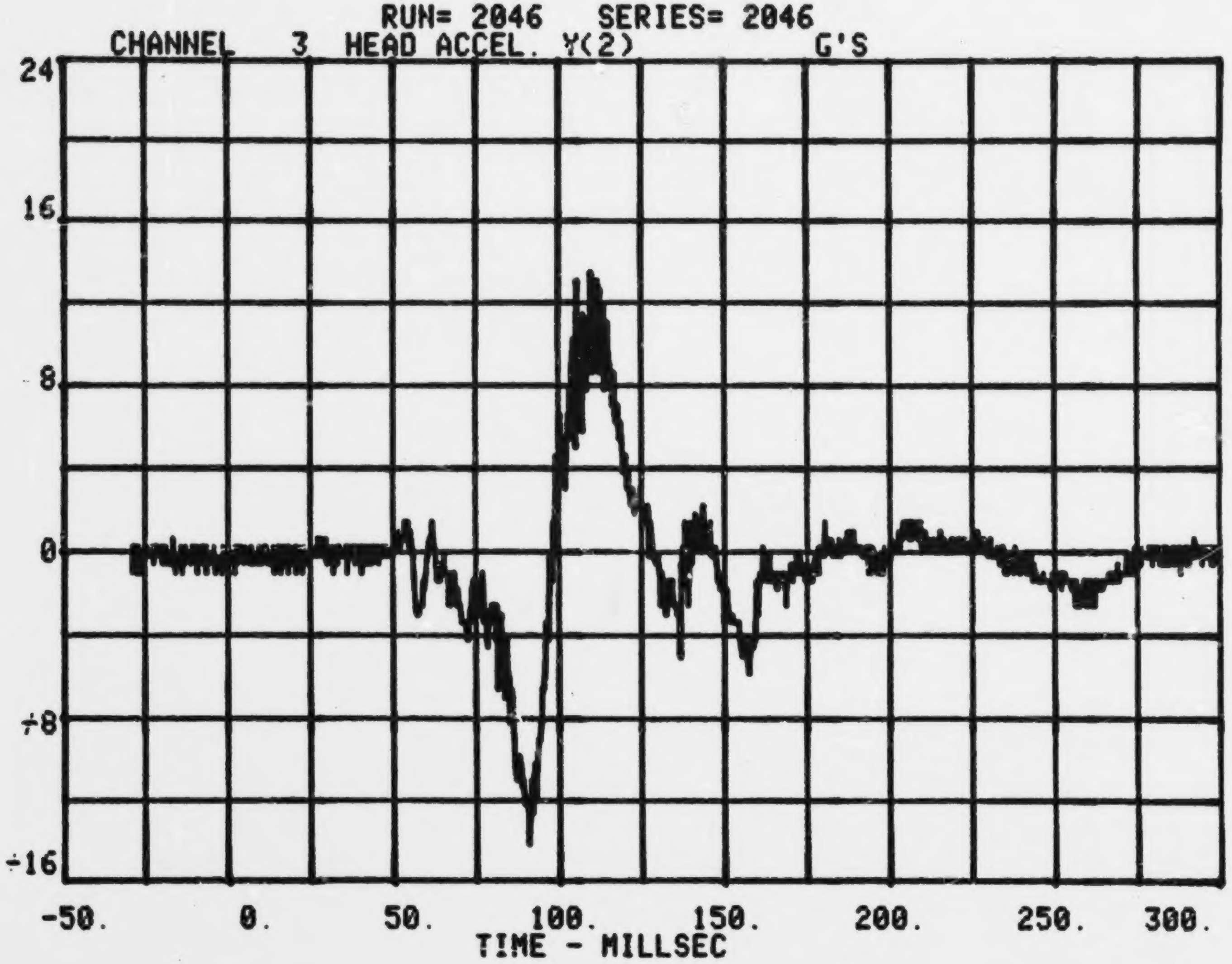

RUN= 2046 SERIES= 2046
CHANNEL 9 HEAD ACCEL. X(0) G'S
-120
-80
-40
0
+40
+80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2046 SERIES= 2046

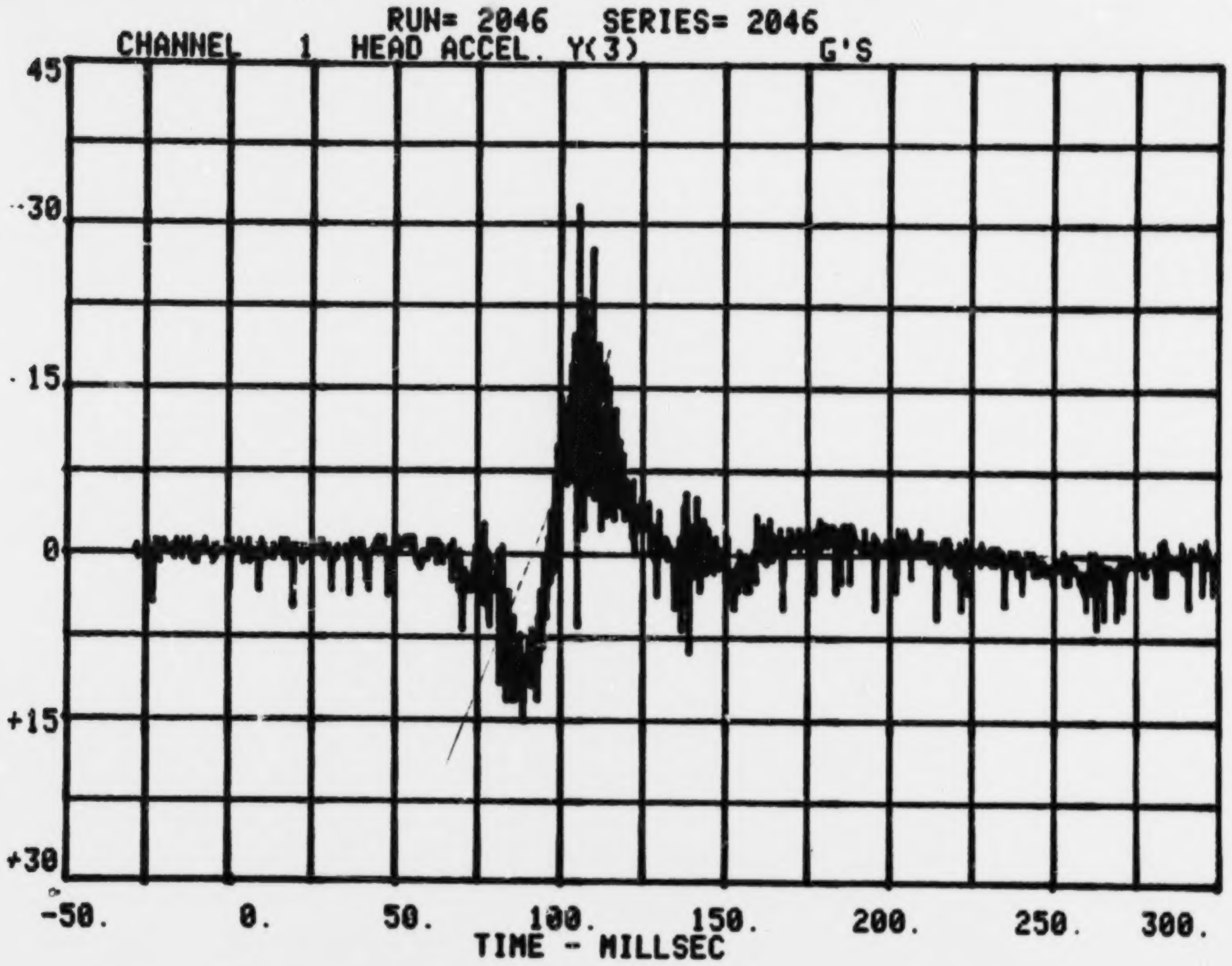
CHANNEL 10 HEAD ACCEL. X(1) G'S


RUN= 2046 SERIES= 2046
CHANNEL 7 HEAD ACCEL. X(3) G'S
150
100
50
0
-50
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

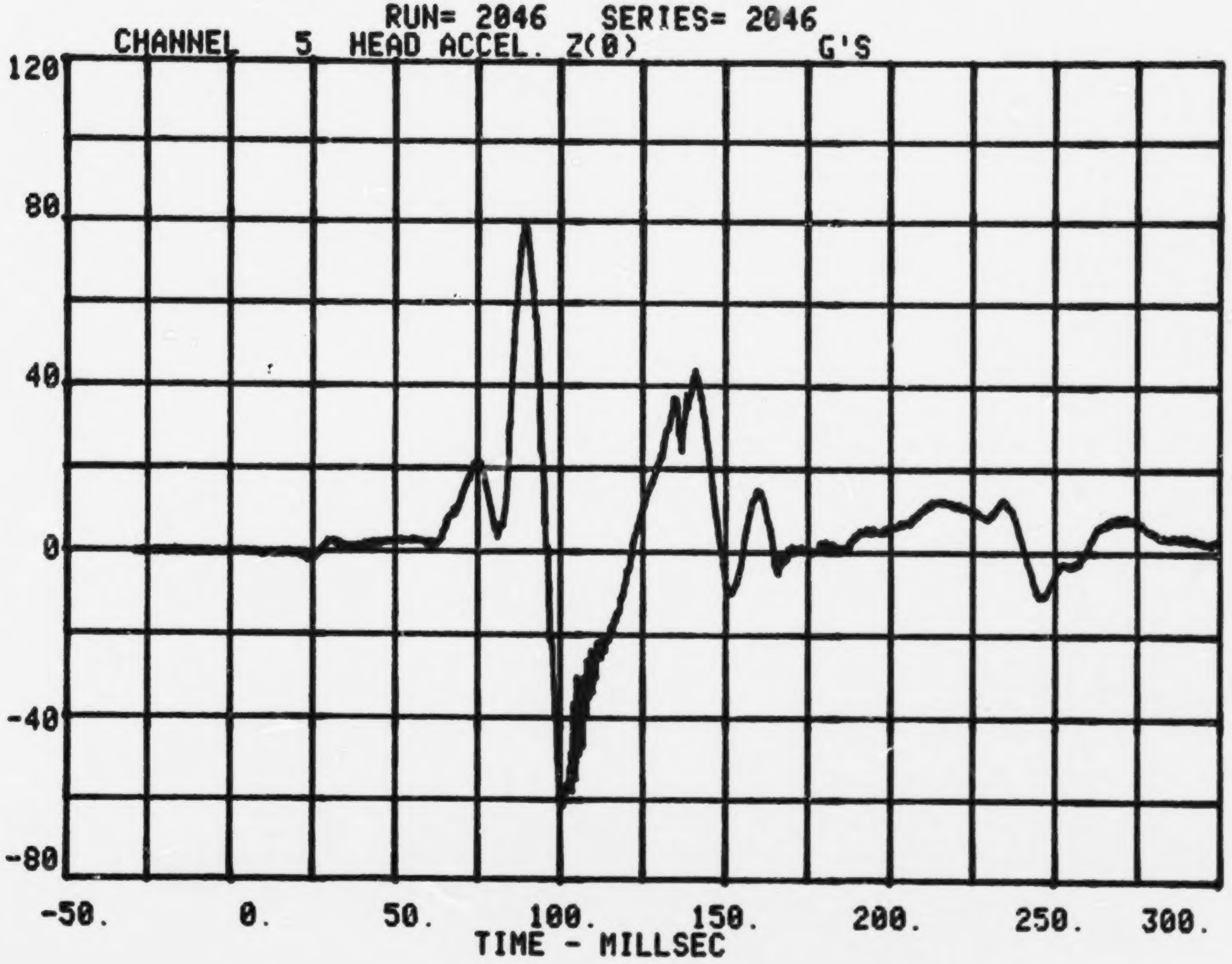

RUN= 2046 SERIES= 2046
CHANNEL 2 HEAD ACCEL. Y(0) G'S
24
16
8
0
+8
-16
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

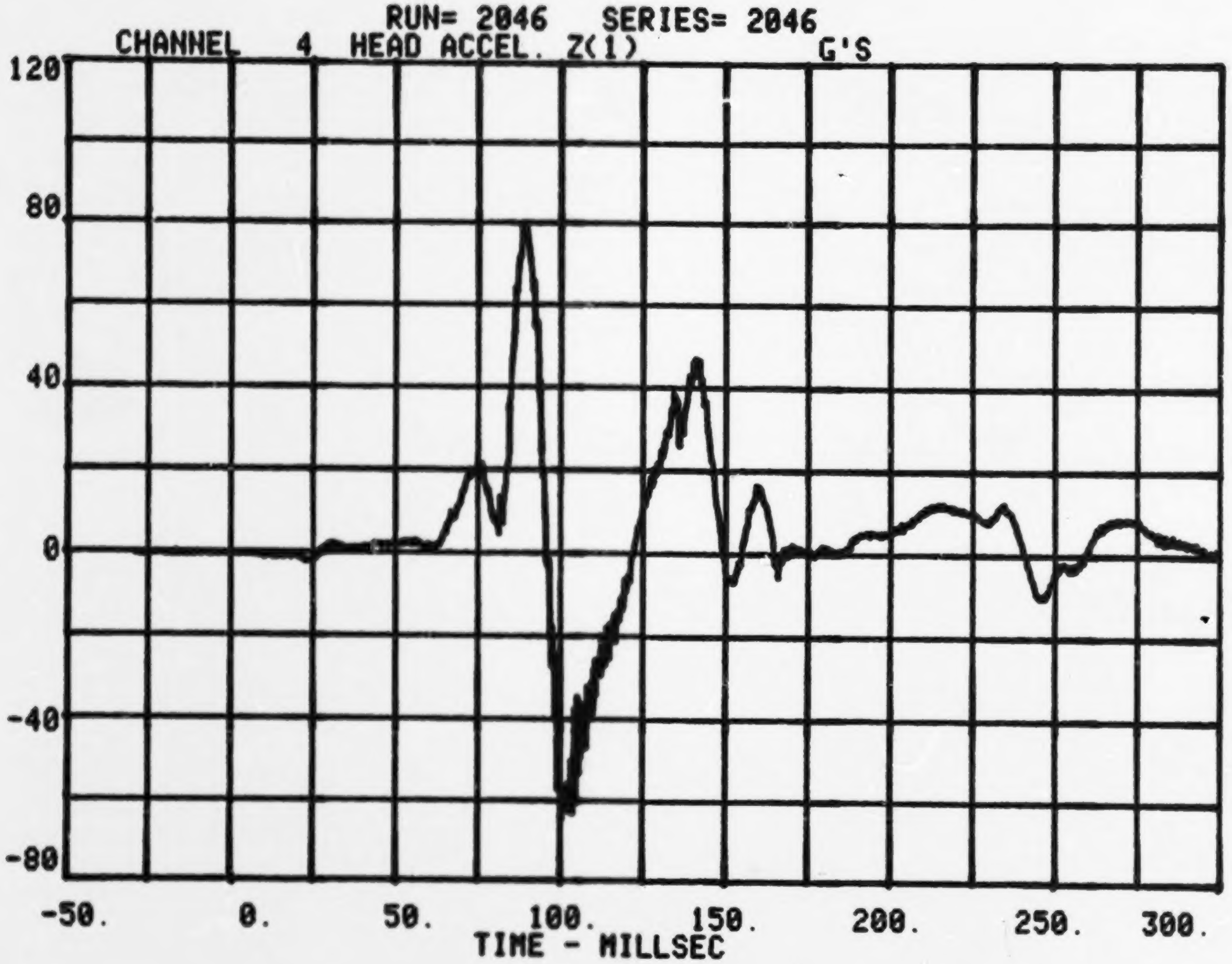


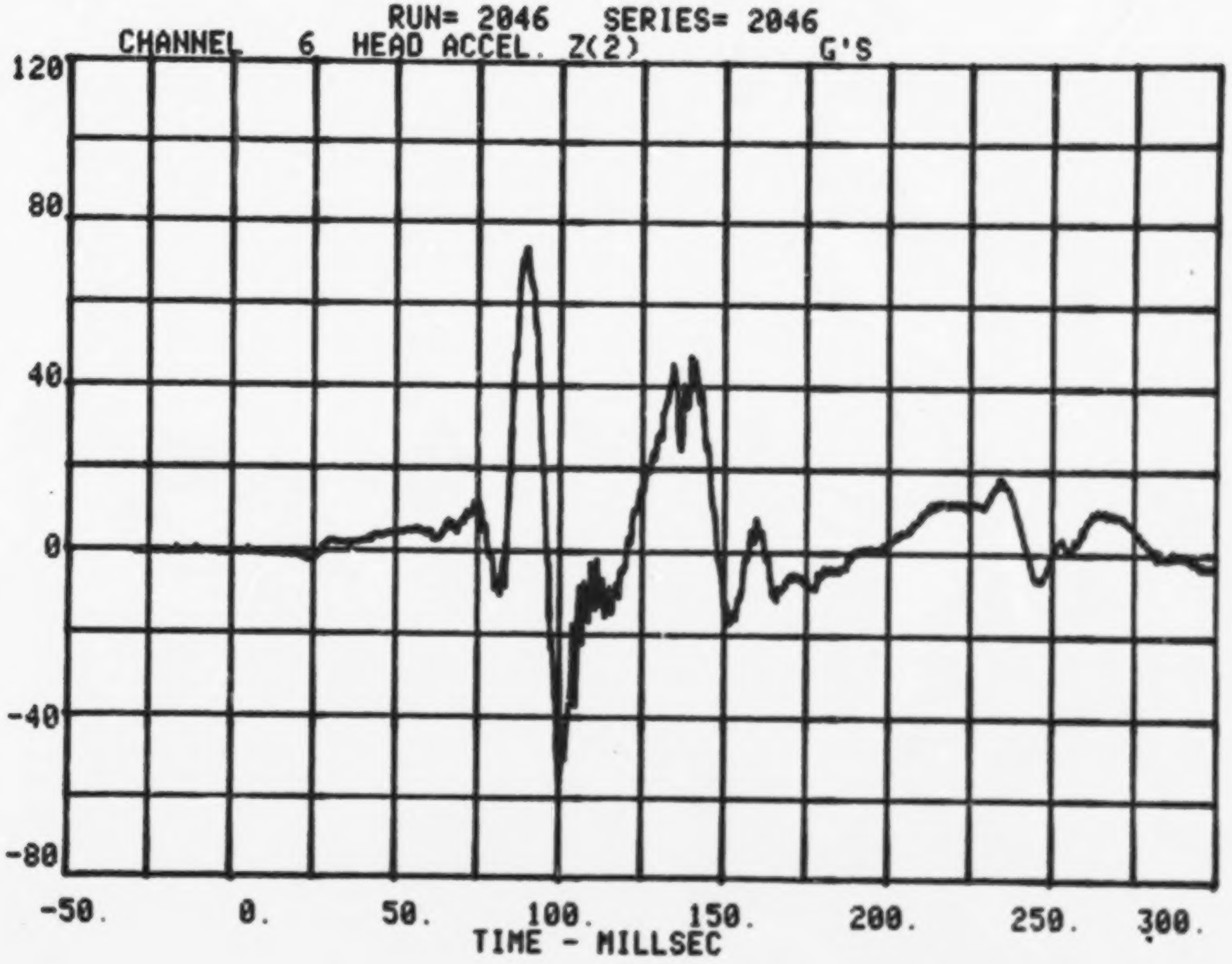
BEST DOCUMENT AVAILABLE

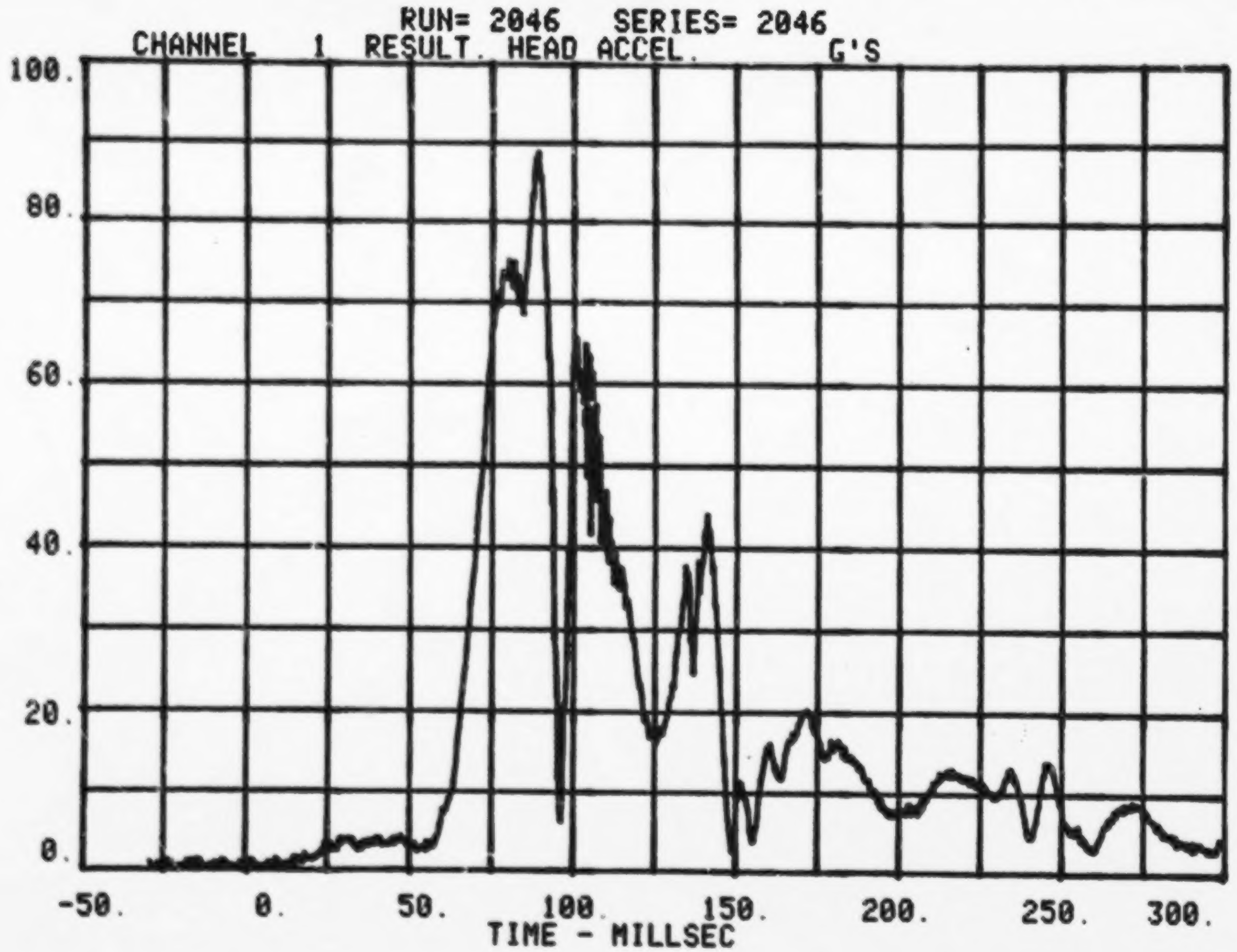


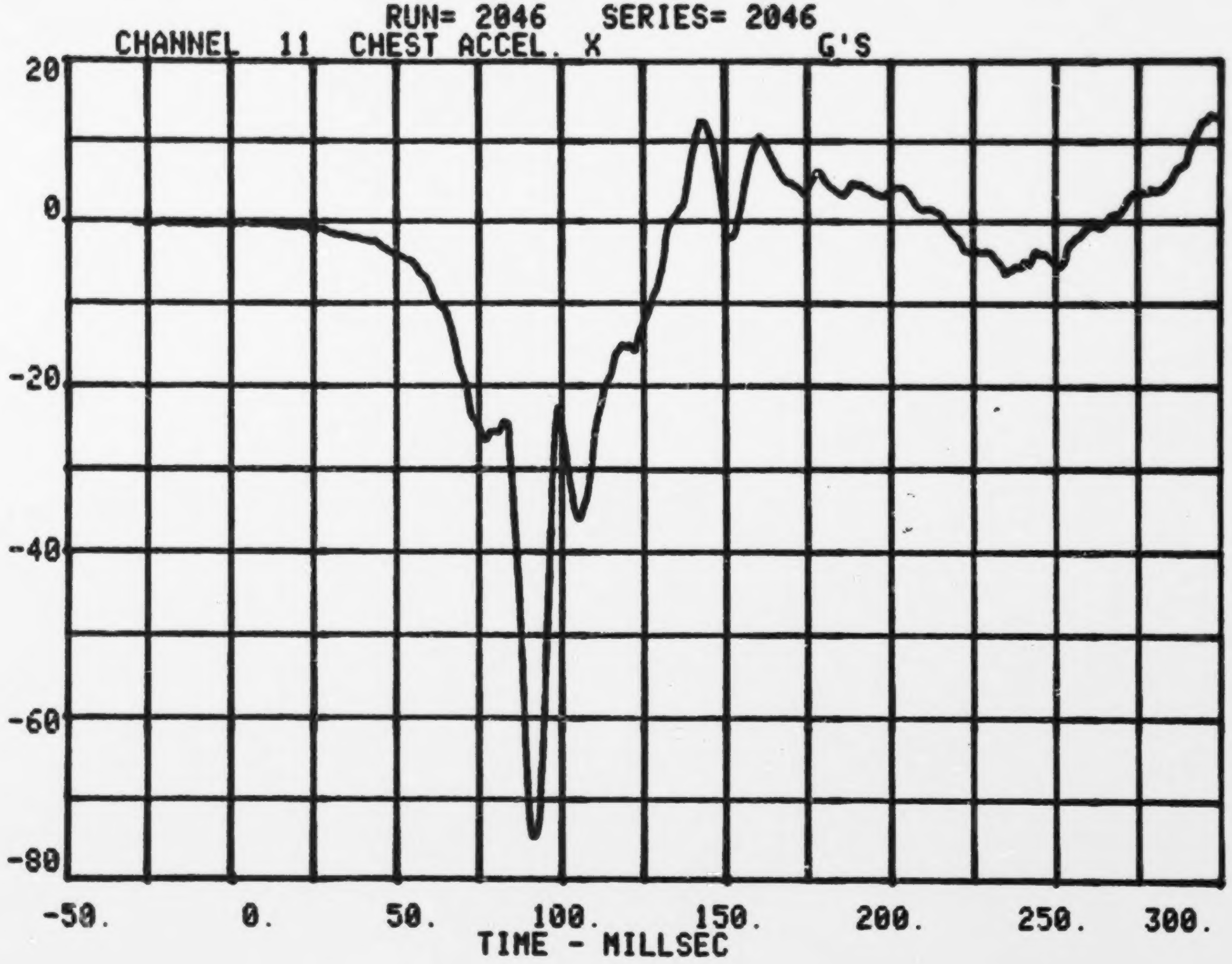
BEST DOCUMENT AVAILABLE

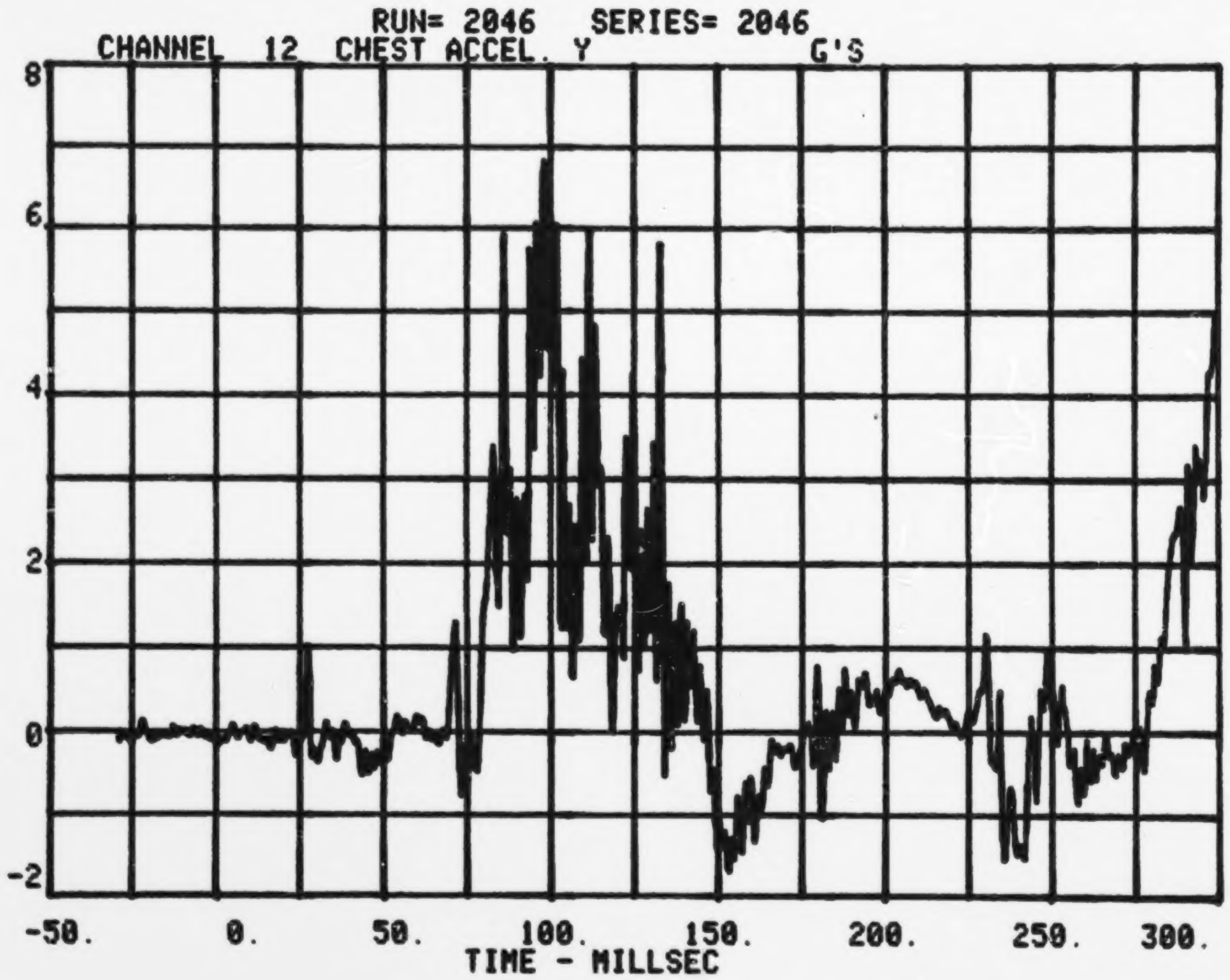

RUN= 2046 SERIES= 2046
CHANNEL 5 HEAD ACCEL. Z(0) G'S
120
80
40
0
-40
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2046 SERIES= 2046
CHANNEL 4 HEAD ACCEL. Z(1) G'S
120
80
40
0
-40
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

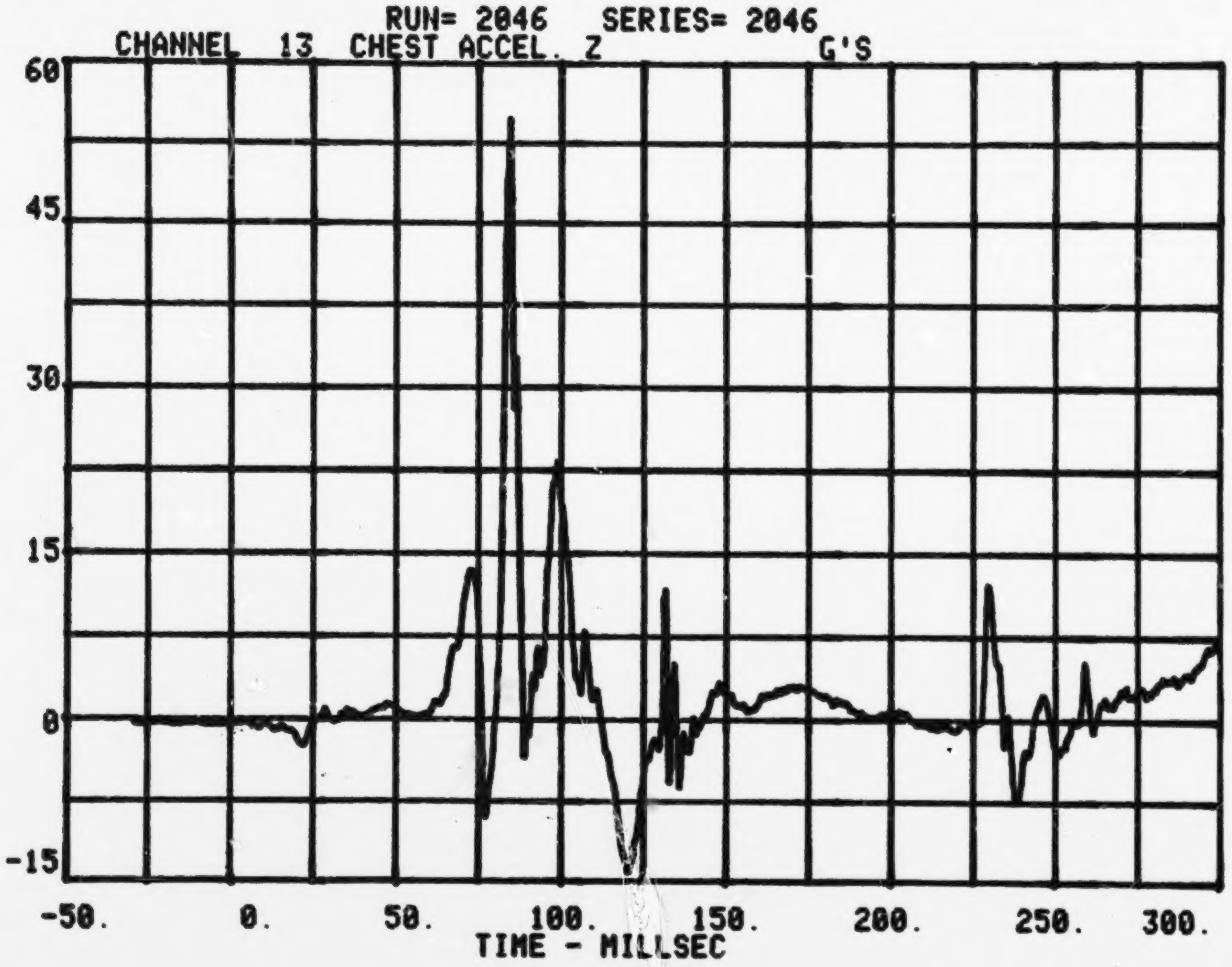

RUN= 2046 SERIES= 2046
CHANNEL 6 HEAD ACCEL. Z(2) G'S
120
80
40
0
-40
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2046 SERIES= 2046
CHANNEL 1 RESULT. HEAD ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2046 SERIES= 2046
CHANNEL 11 CHEST ACCEL. X
G'S
20
0
-20
-40
-60
-80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



BEST DOCUMENT AVAILABLE



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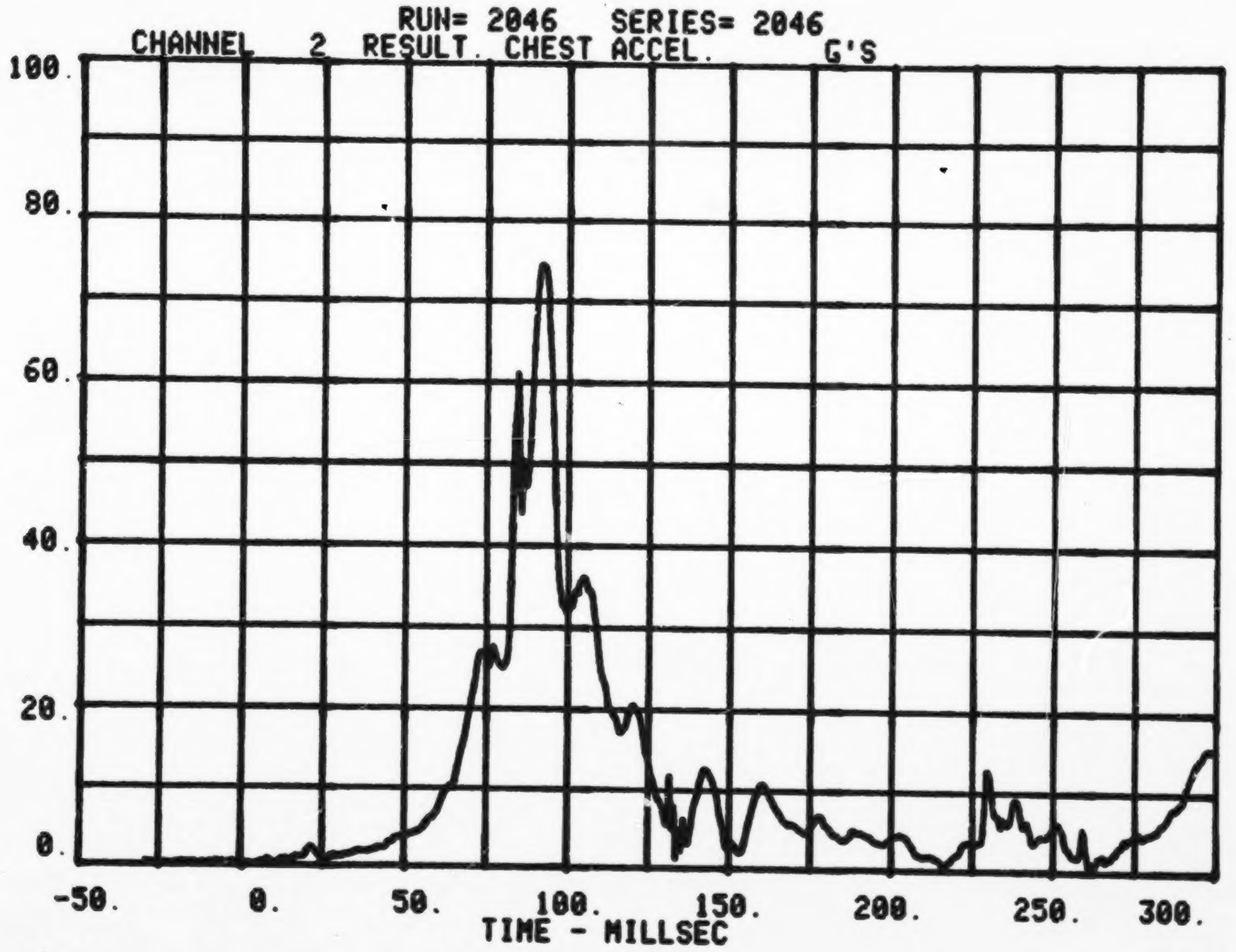
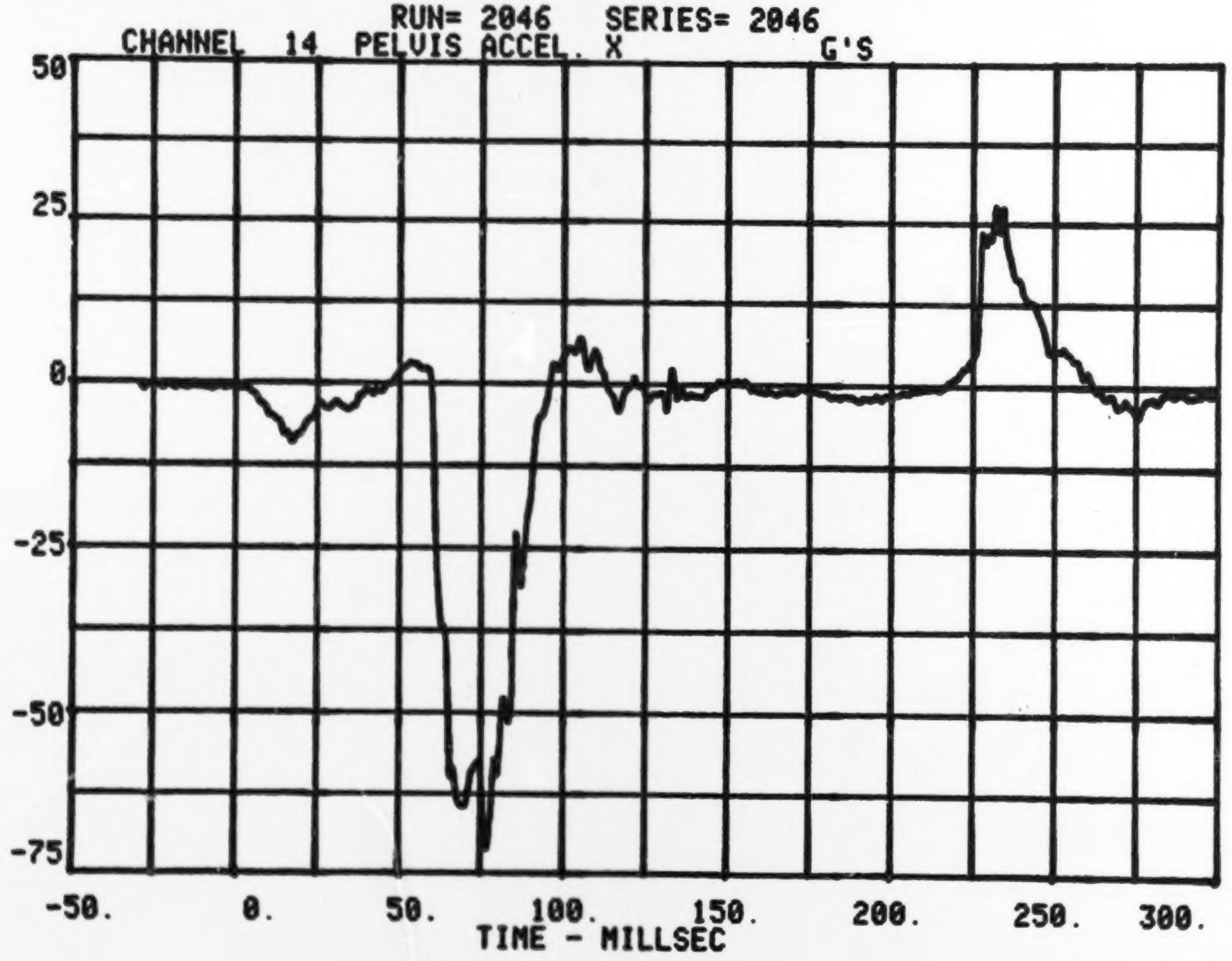
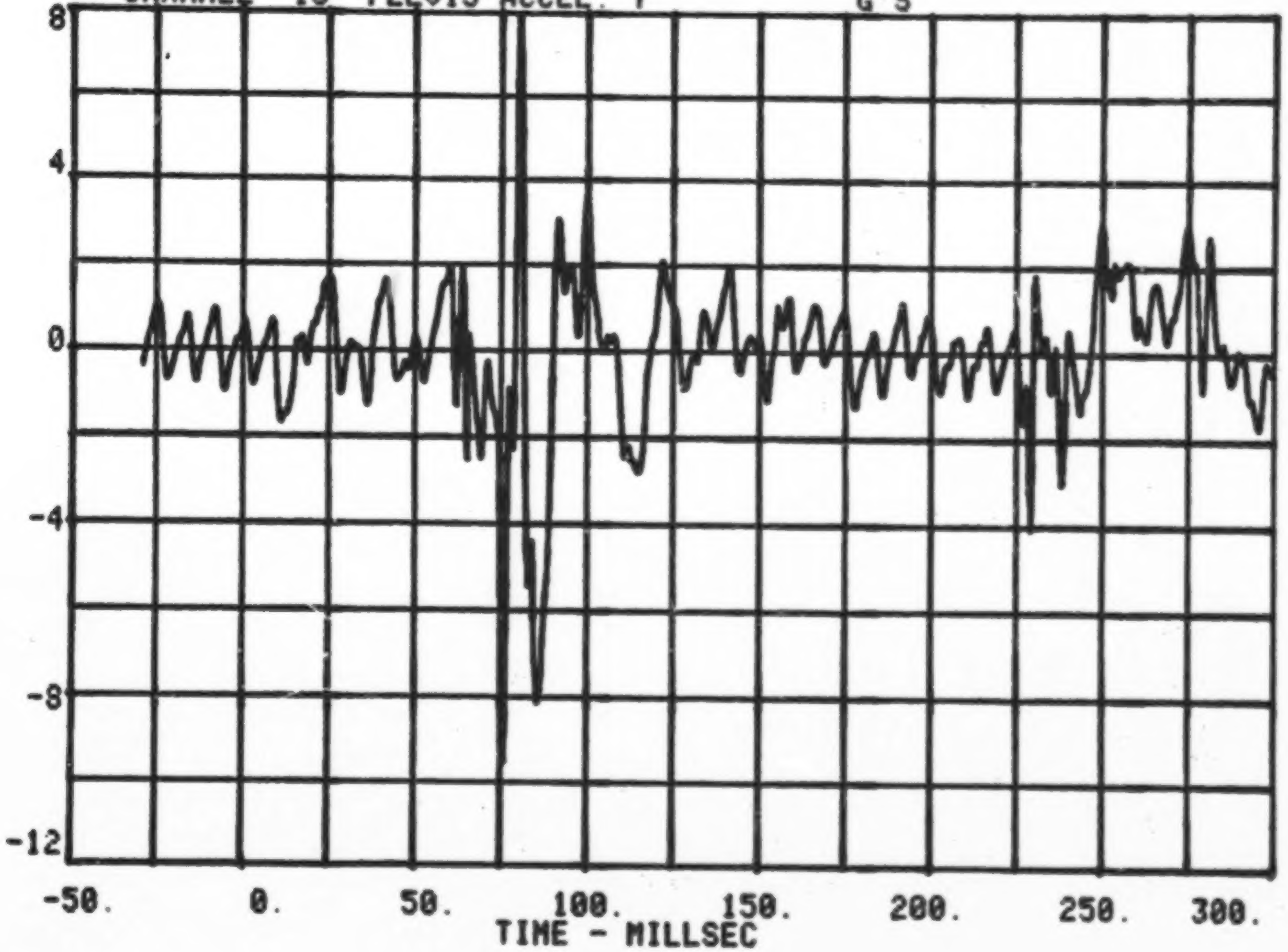
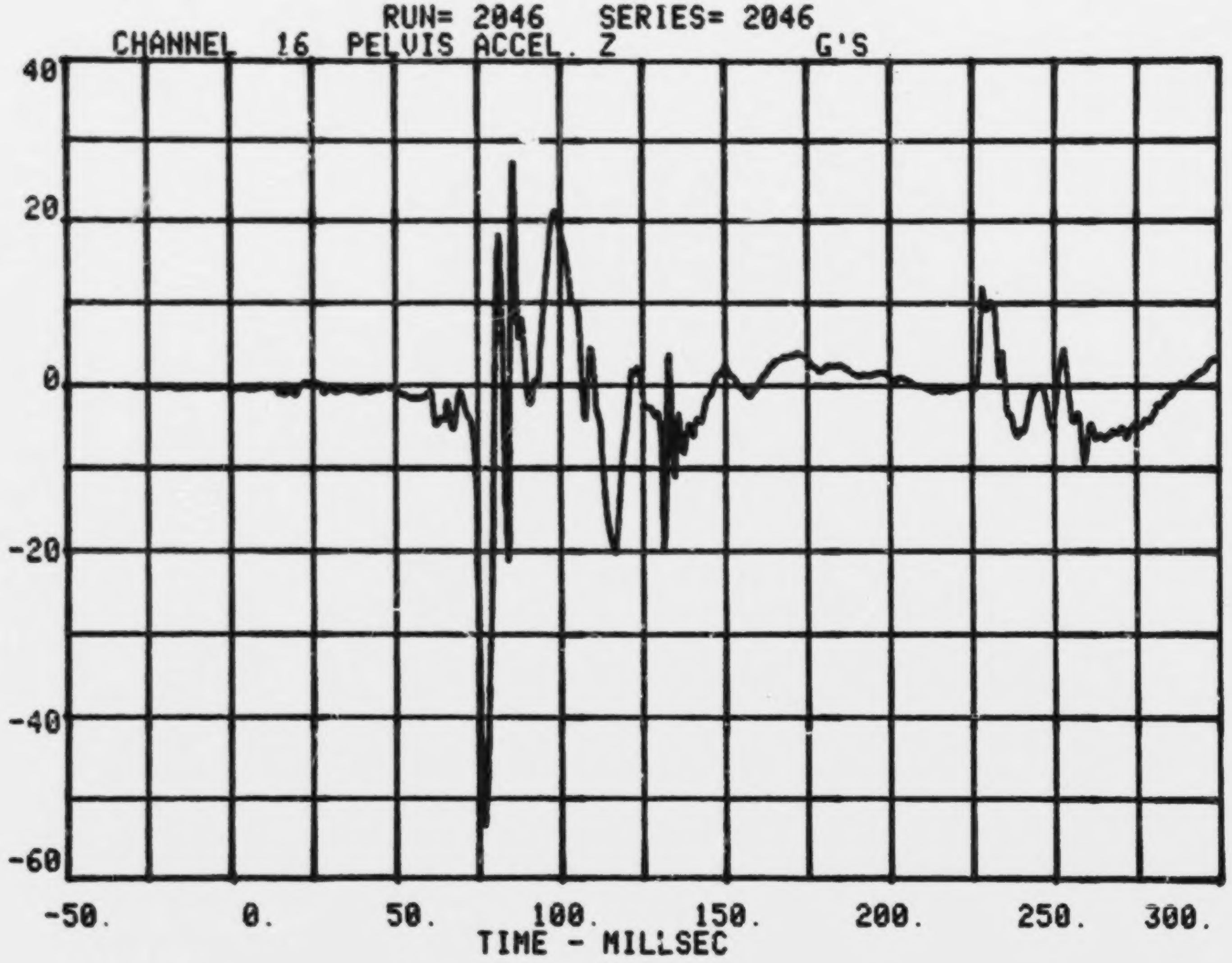

RUN= 2046 SERIES= 2046
CHANNEL 2 RESULT. CHEST ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



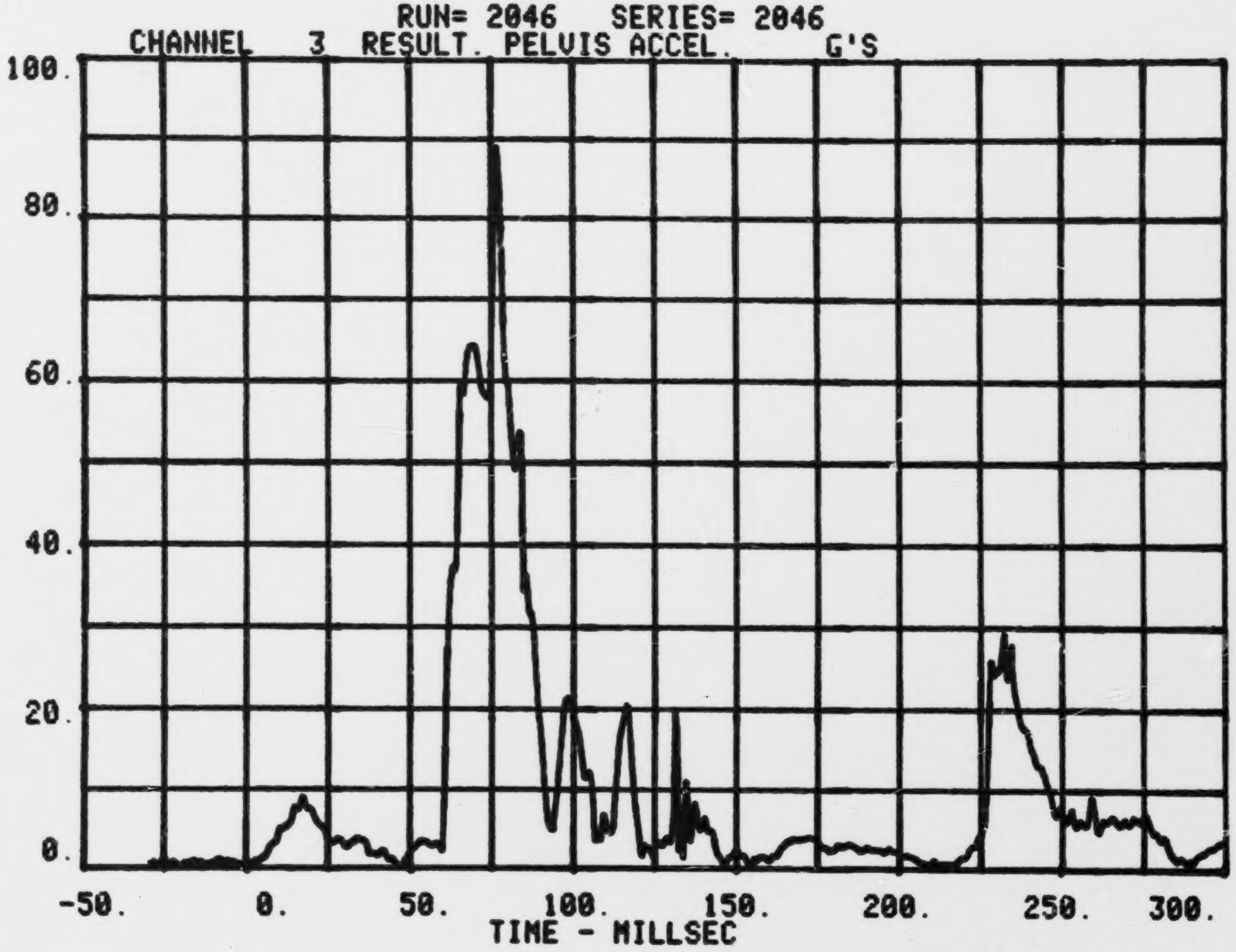
BEST DOCUMENT AVAILABLE

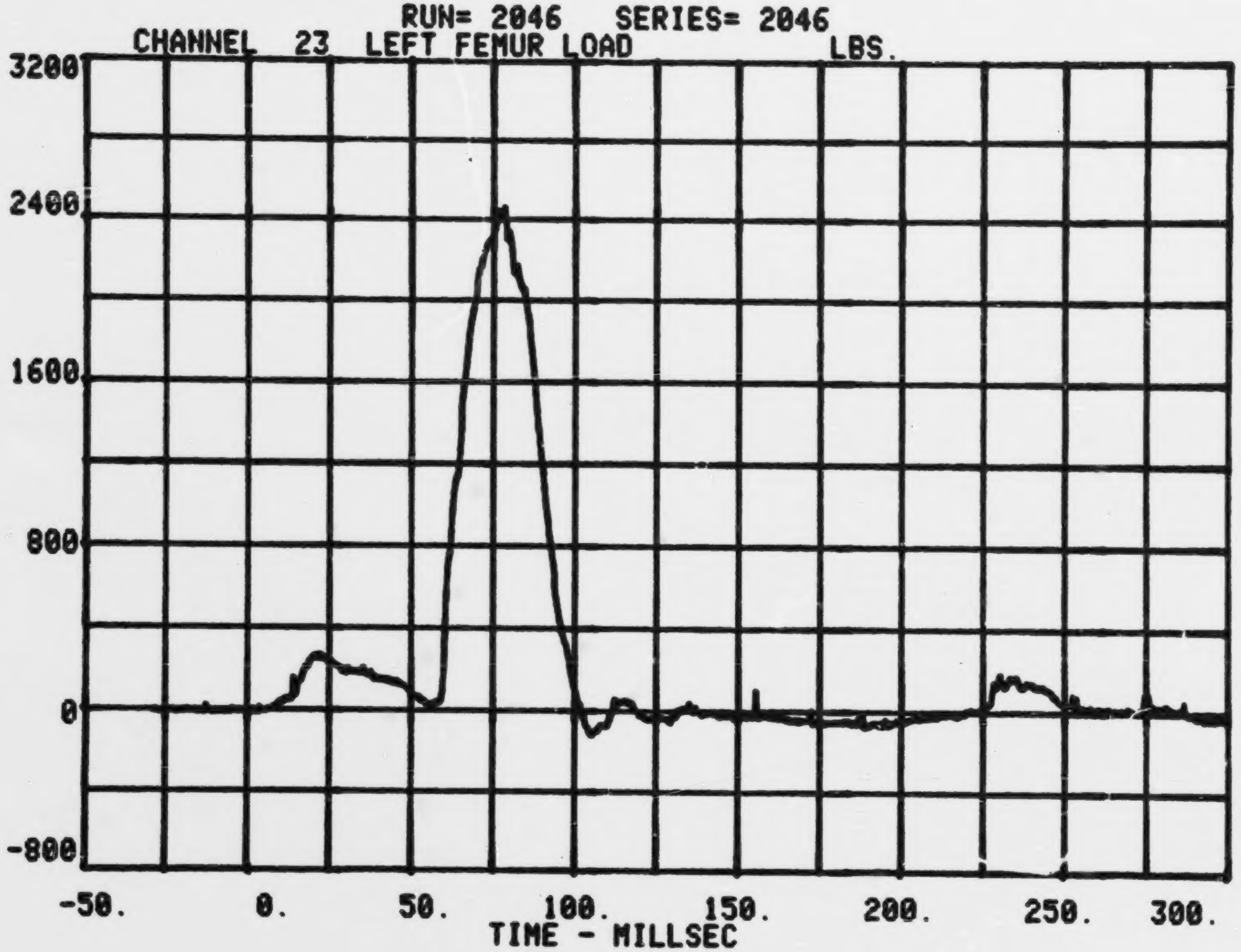
RUN= 2046 SERIES= 2046
CHANNEL 15 PELVIS ACCEL. Y G'S

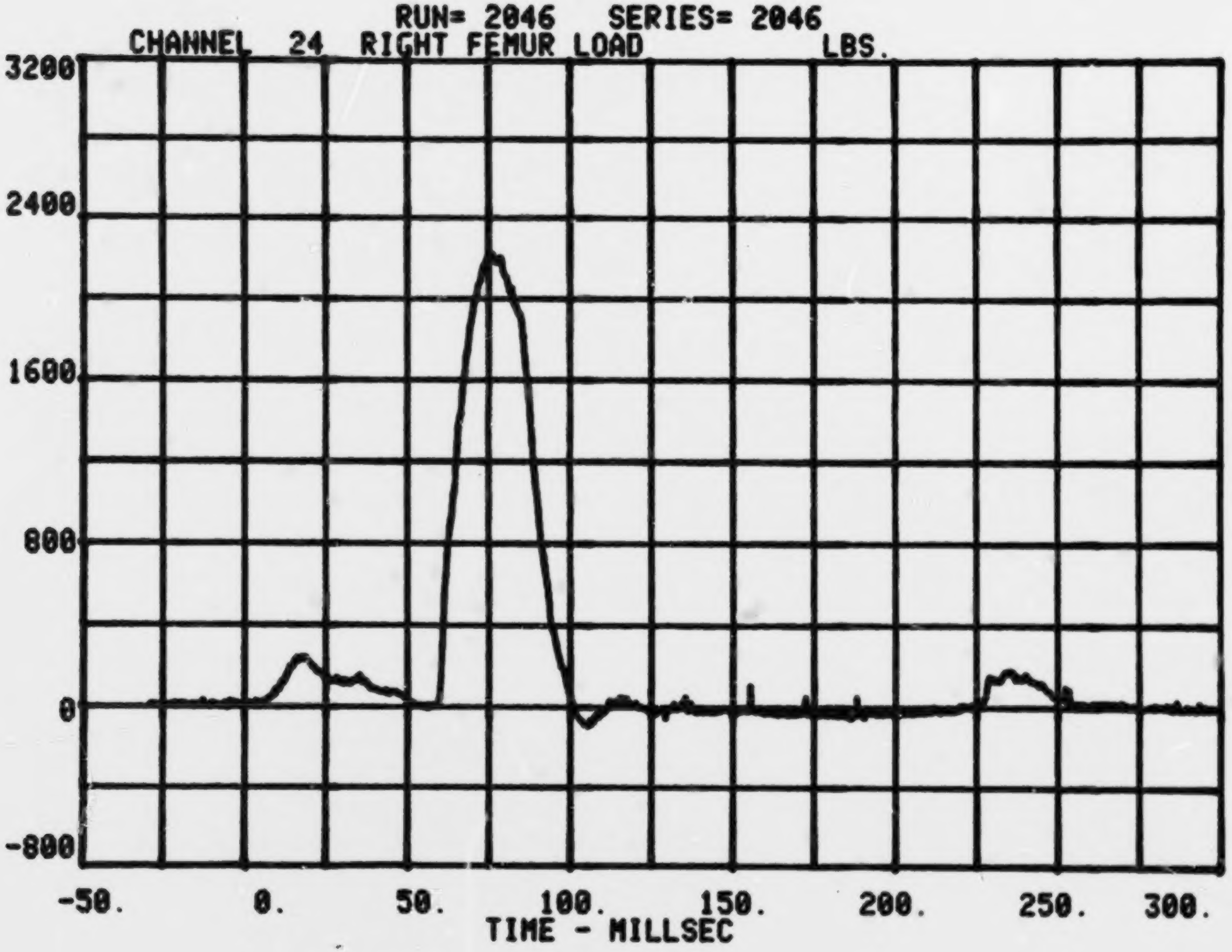




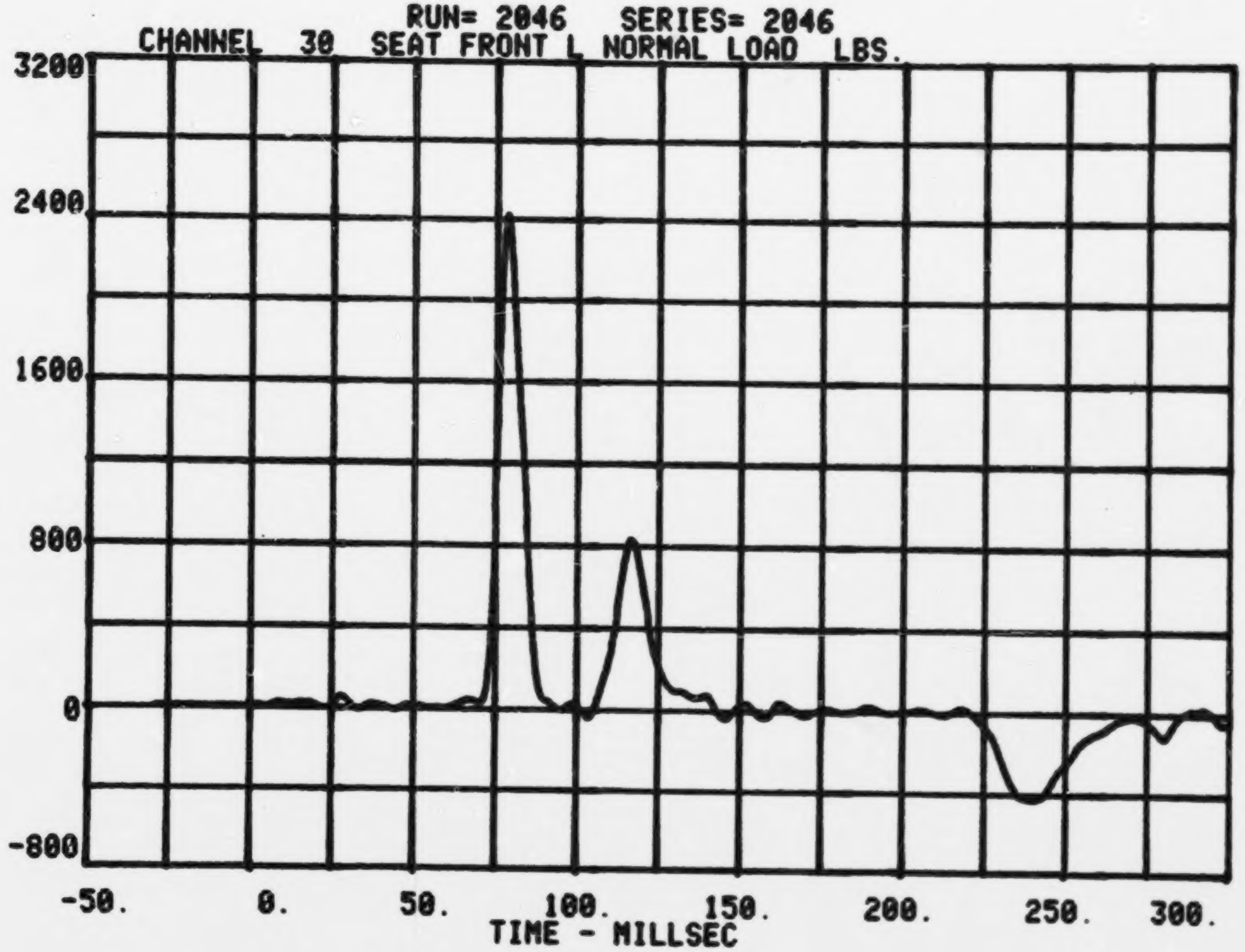
BEST DOCUMENT AVAILABLE


RUN= 2046 SERIES= 2046
CHANNEL 3 RESULT. PELVIS ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

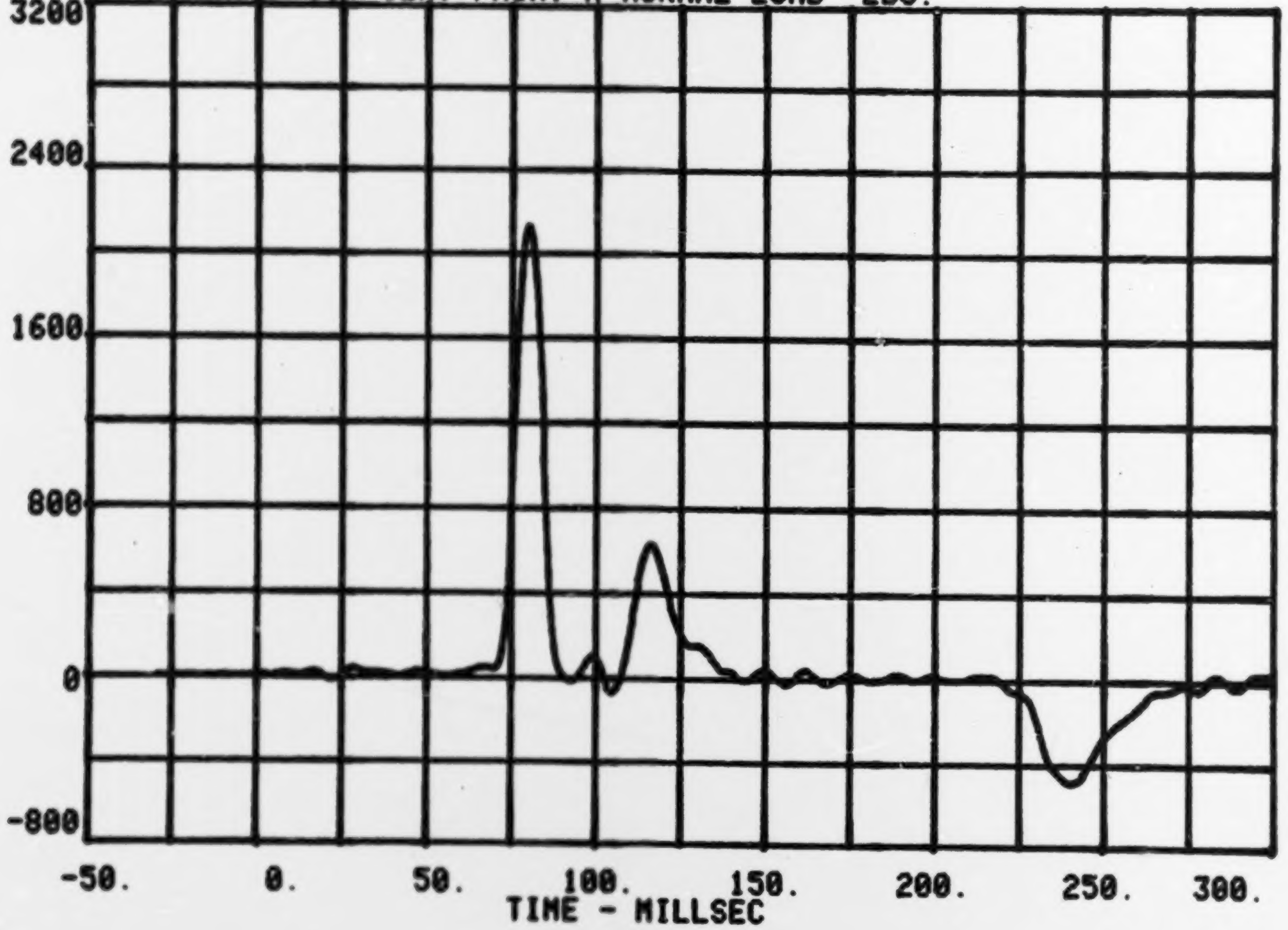

RUN= 2046 SERIES= 2046
CHANNEL 23 LEFT FEMUR LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



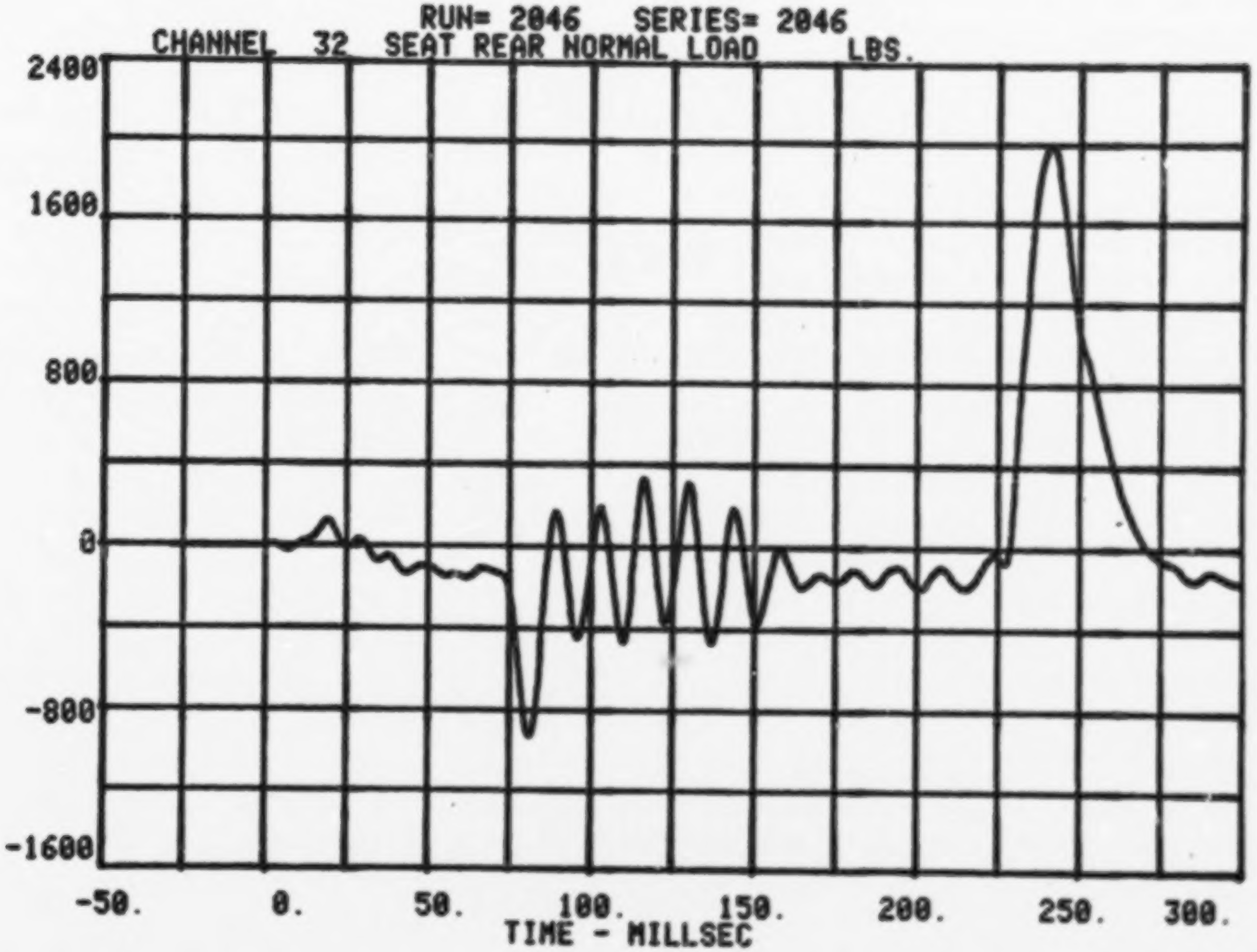
BEST DOCUMENT AVAILABLE


RUN= 2046 SERIES= 2046
CHANNEL 30 SEAT FRONT L NORMAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

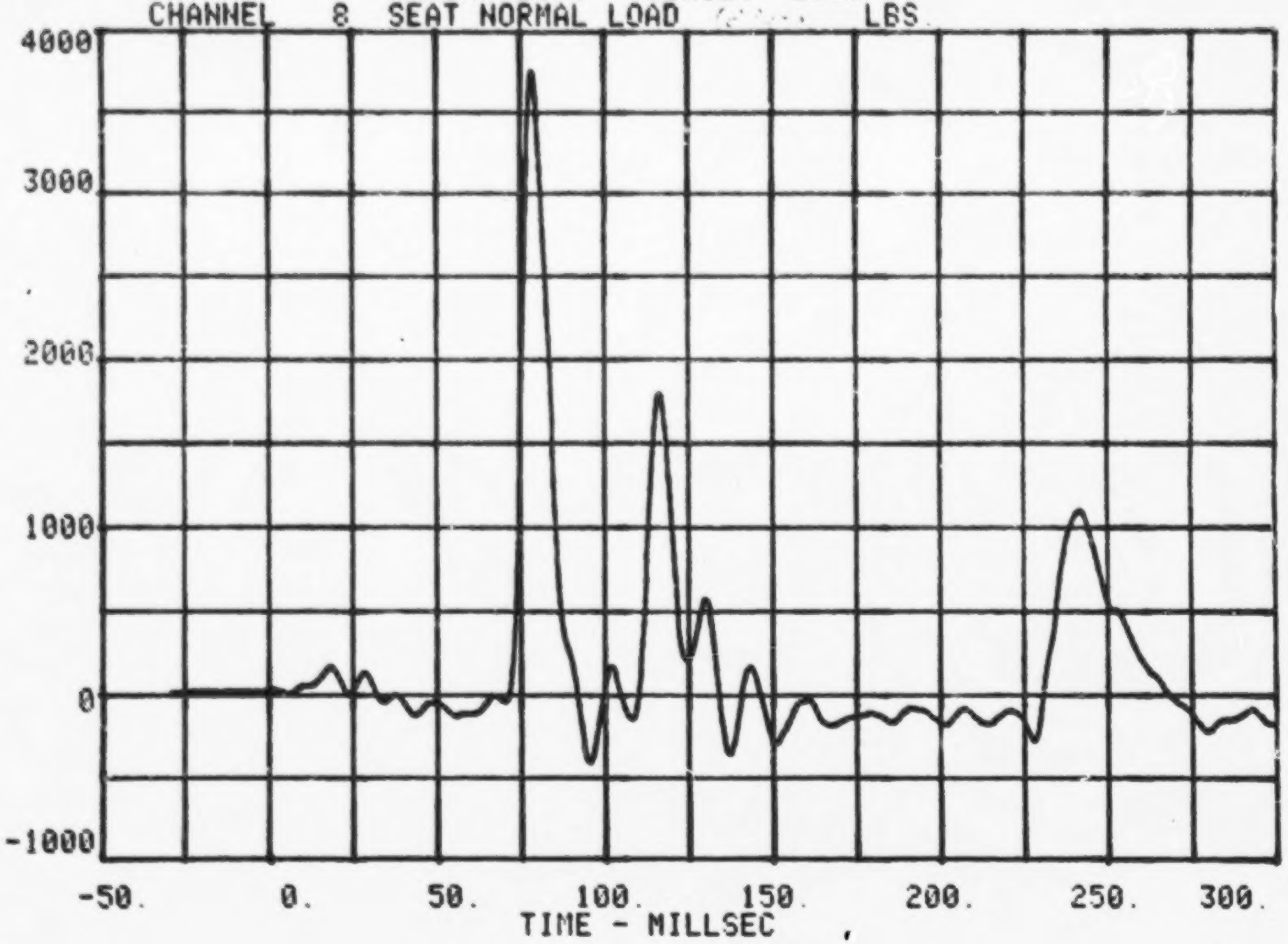
RUN= 2046 SERIES= 2046
CHANNEL 31 SEAT FRONT R NORMAL LOAD LBS.



BEST DOCUMENT AVAILABLE

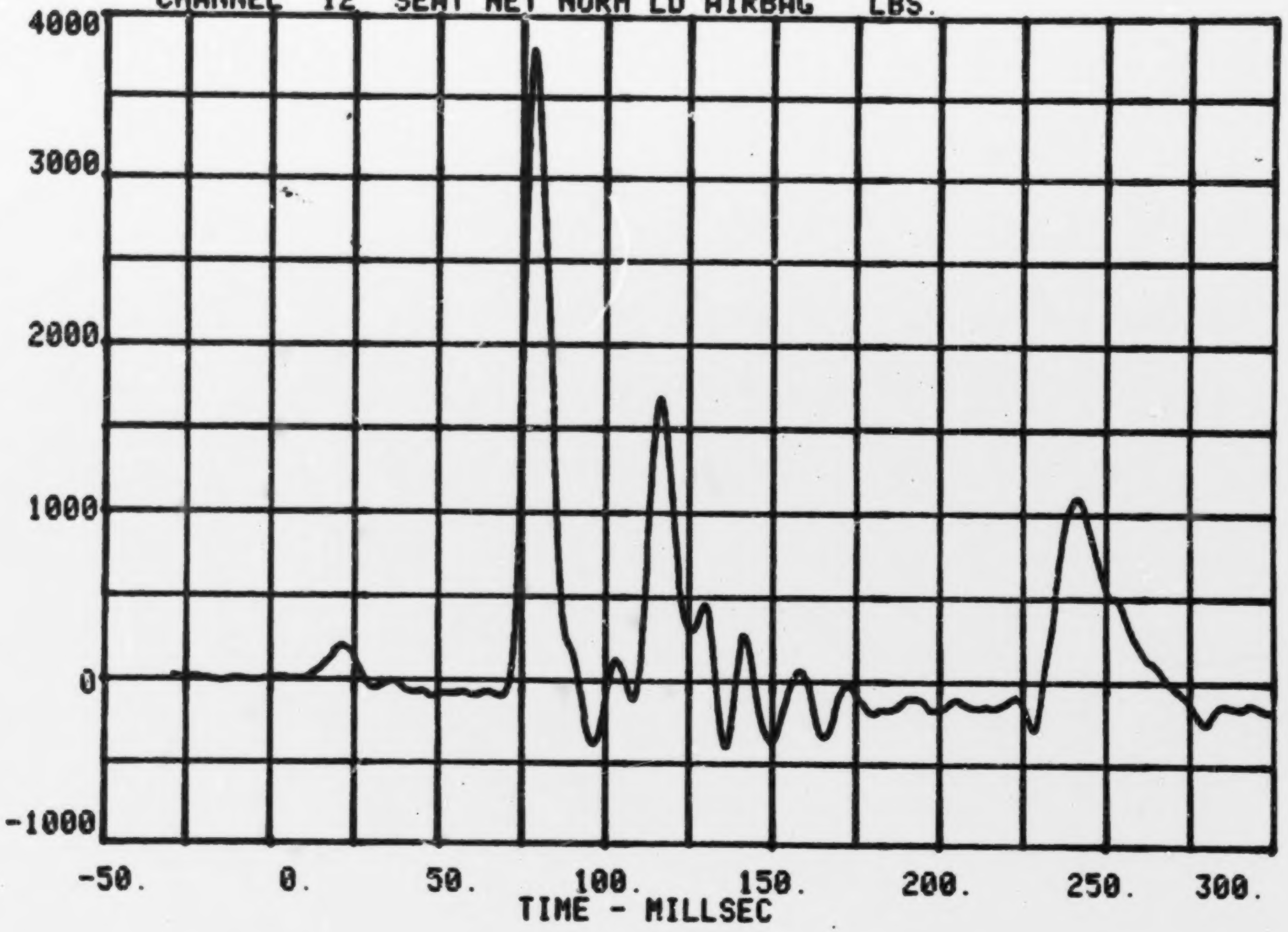

RUN= 2046 SERIES= 2046
CHANNEL 32 SEAT REAR NORMAL LOAD LBS.
2400
1600
800
0
-800
-1600
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

RUN= 2046 SERIES= 2046
CHANNEL 8 SEAT NORMAL LOAD LBS



RUN= 2046 SERIES= 2046

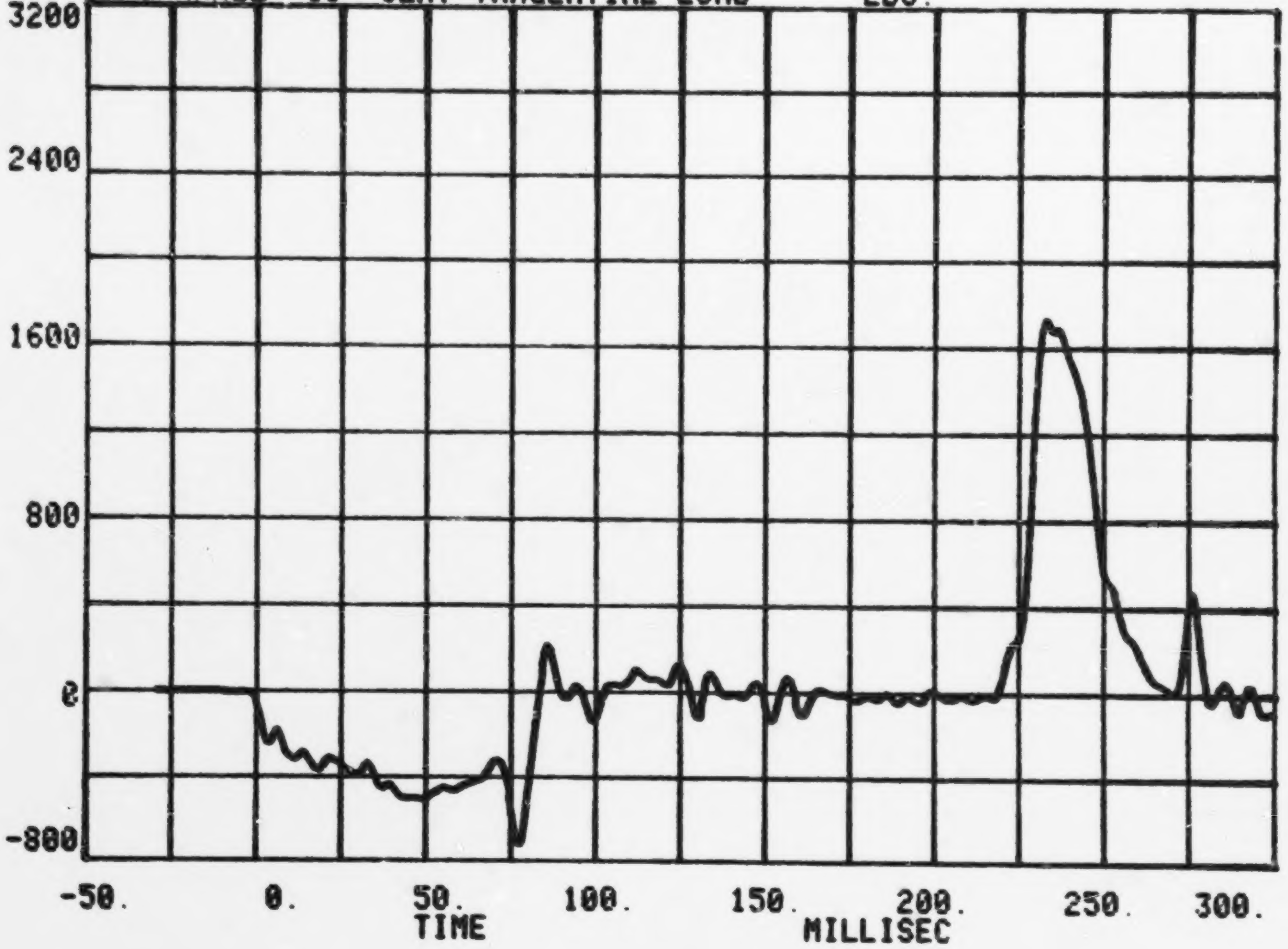
CHANNEL 12 SEAT NET NORM LD AIRBAG LBS.



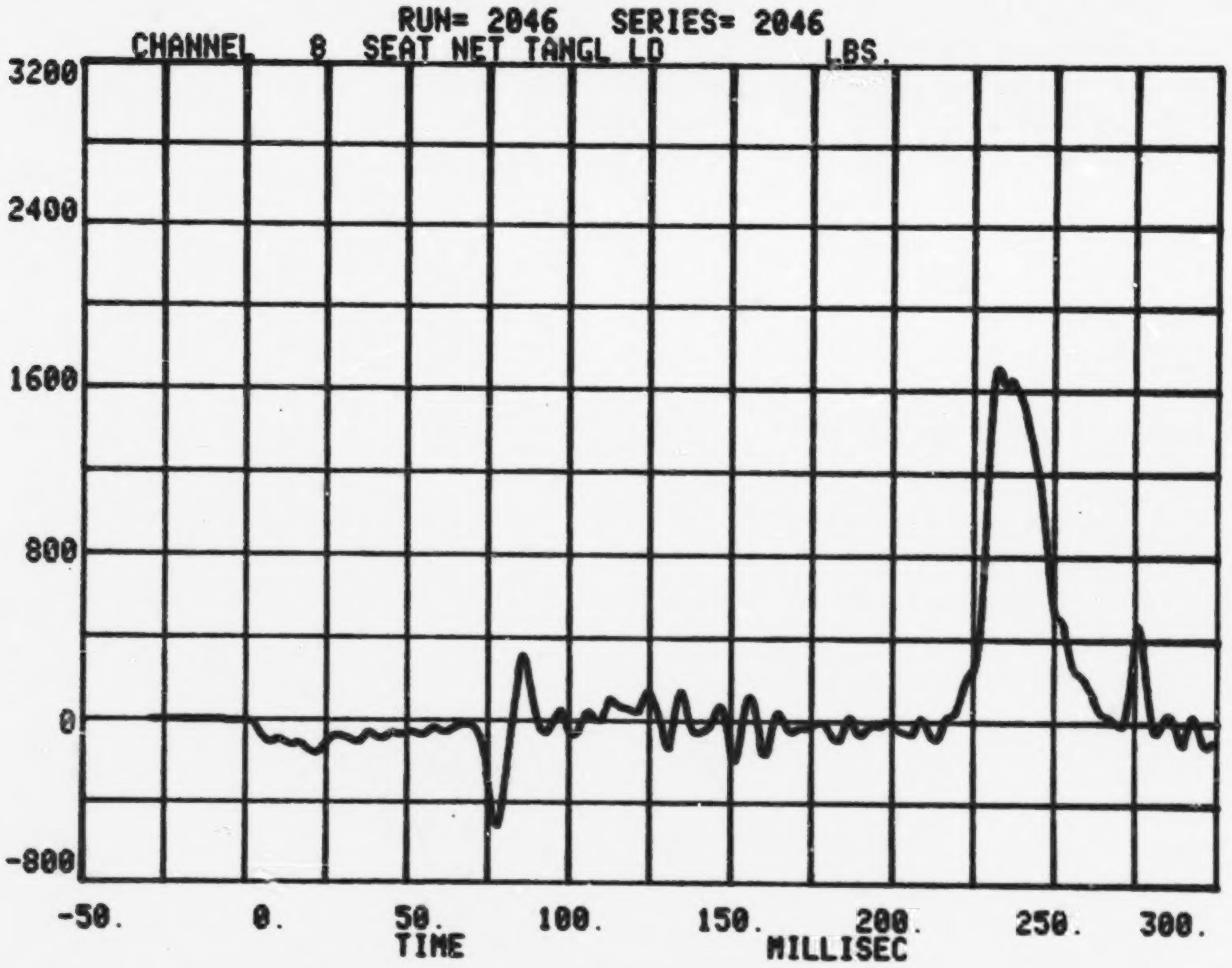
BEST DOCUMENT AVAILABLE

RUN= 2046 SERIES= 2046

CHANNEL 33 SEAT TANGENTIAL LOAD LBS.

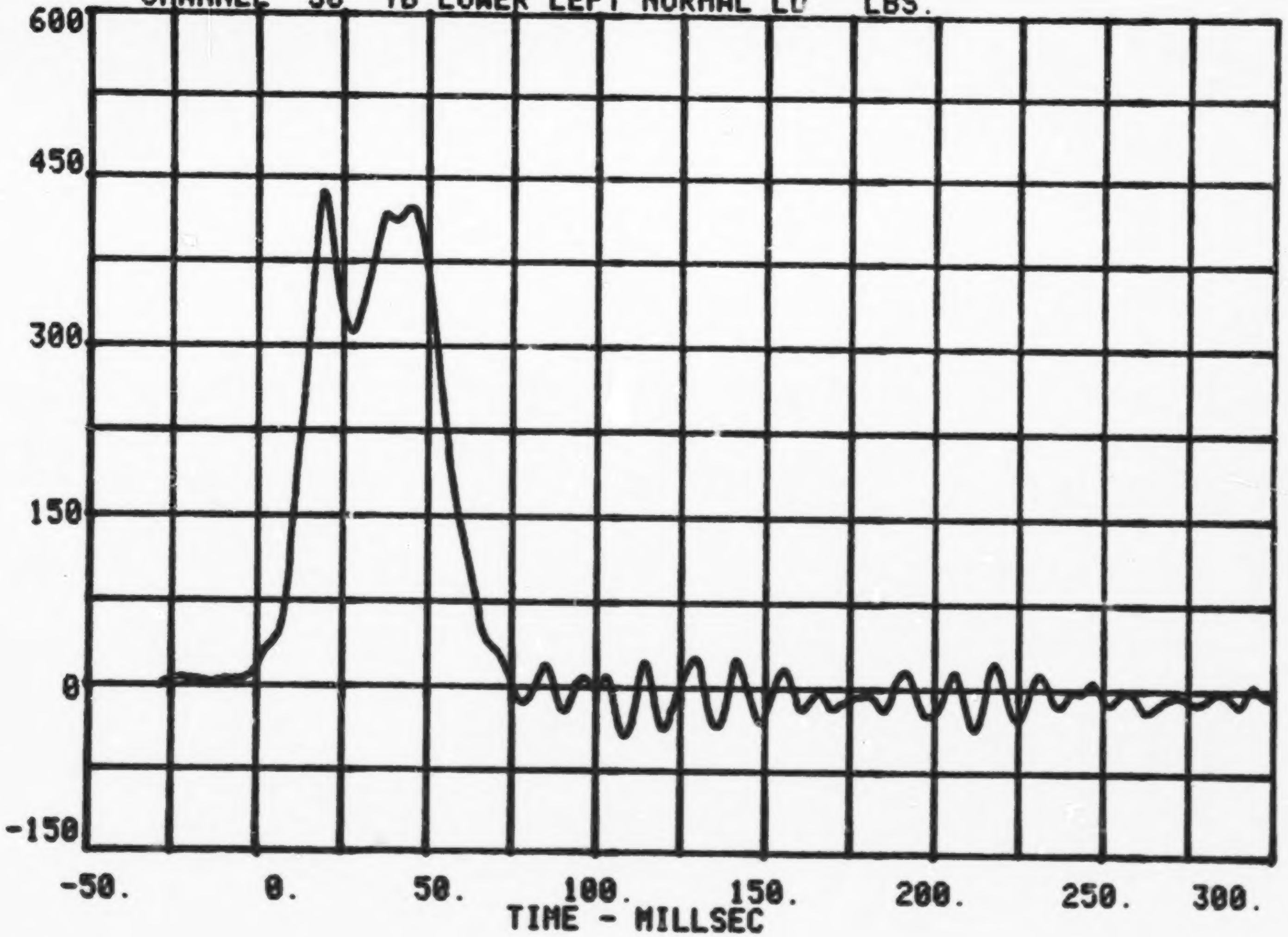


BEST DOCUMENT AVAILABLE

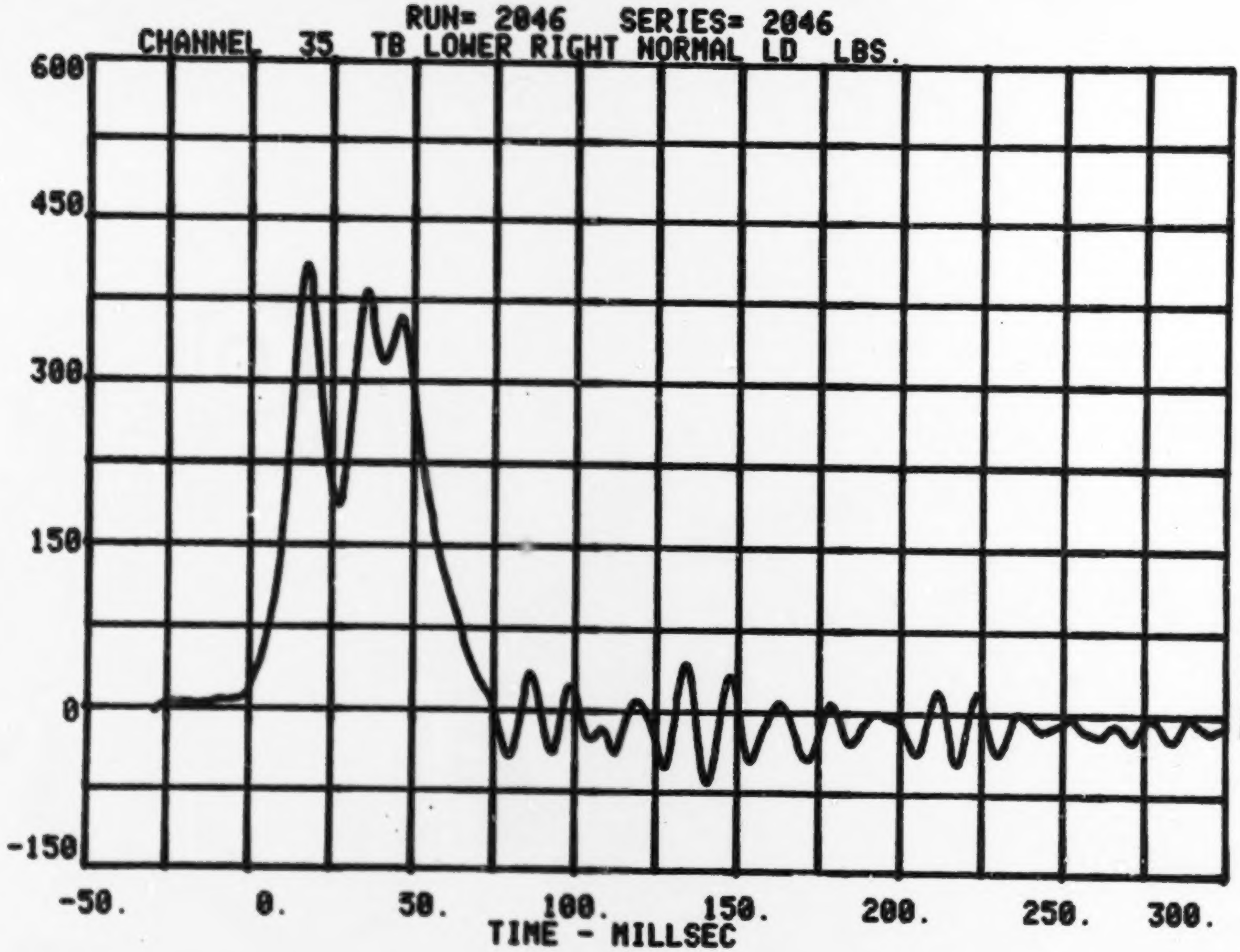

RUN= 2046 SERIES= 2046
CHANNEL 8 SEAT NET TANGL LD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

RUN= 2046 SERIES= 2046

CHANNEL 36 TB LOWER LEFT NORMAL LD LBS.

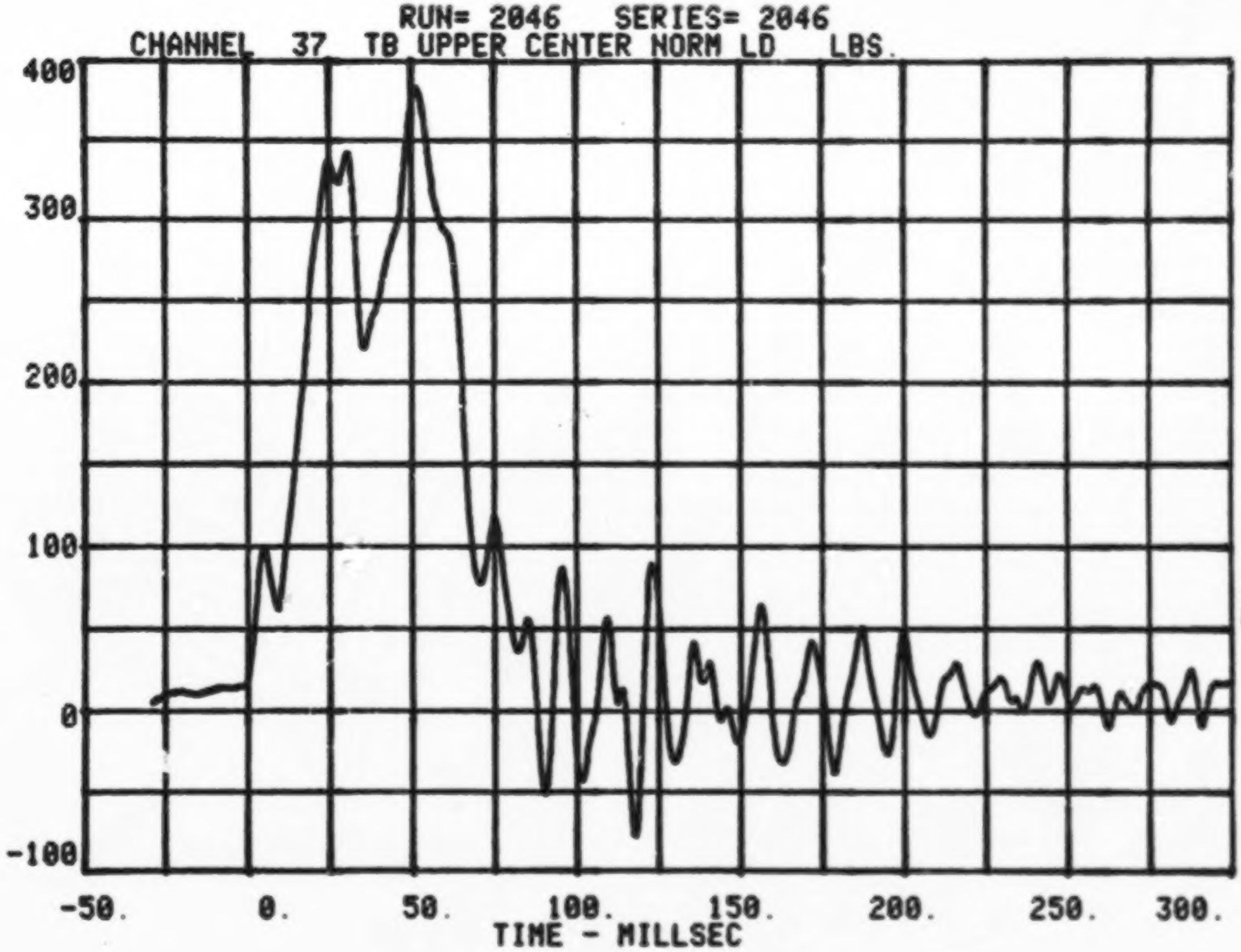


BEST DOCUMENT AVAILABLE

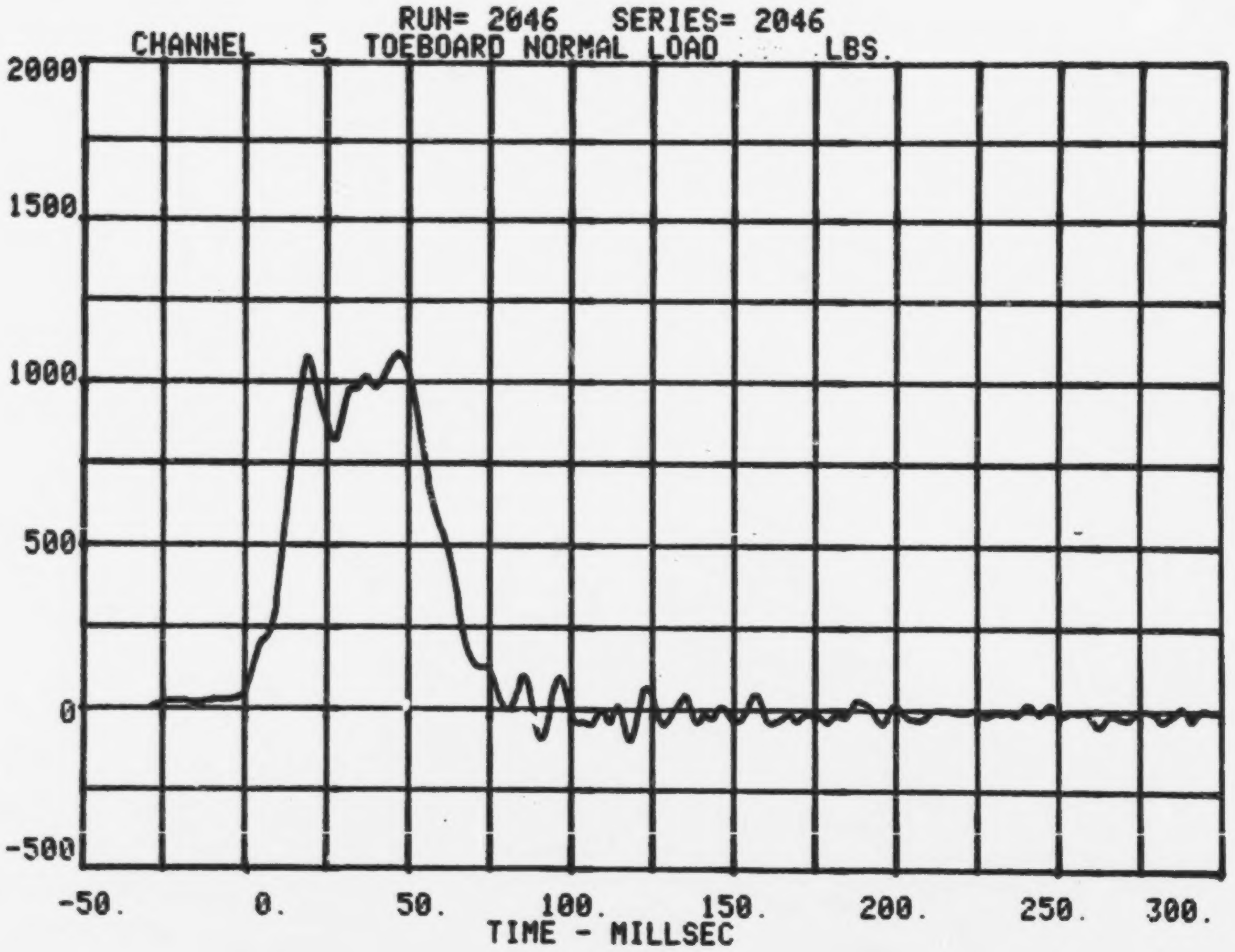


RUN= 2046 SERIES= 2046

CHANNEL 35 TB LOWER RIGHT NORMAL LD LBS.

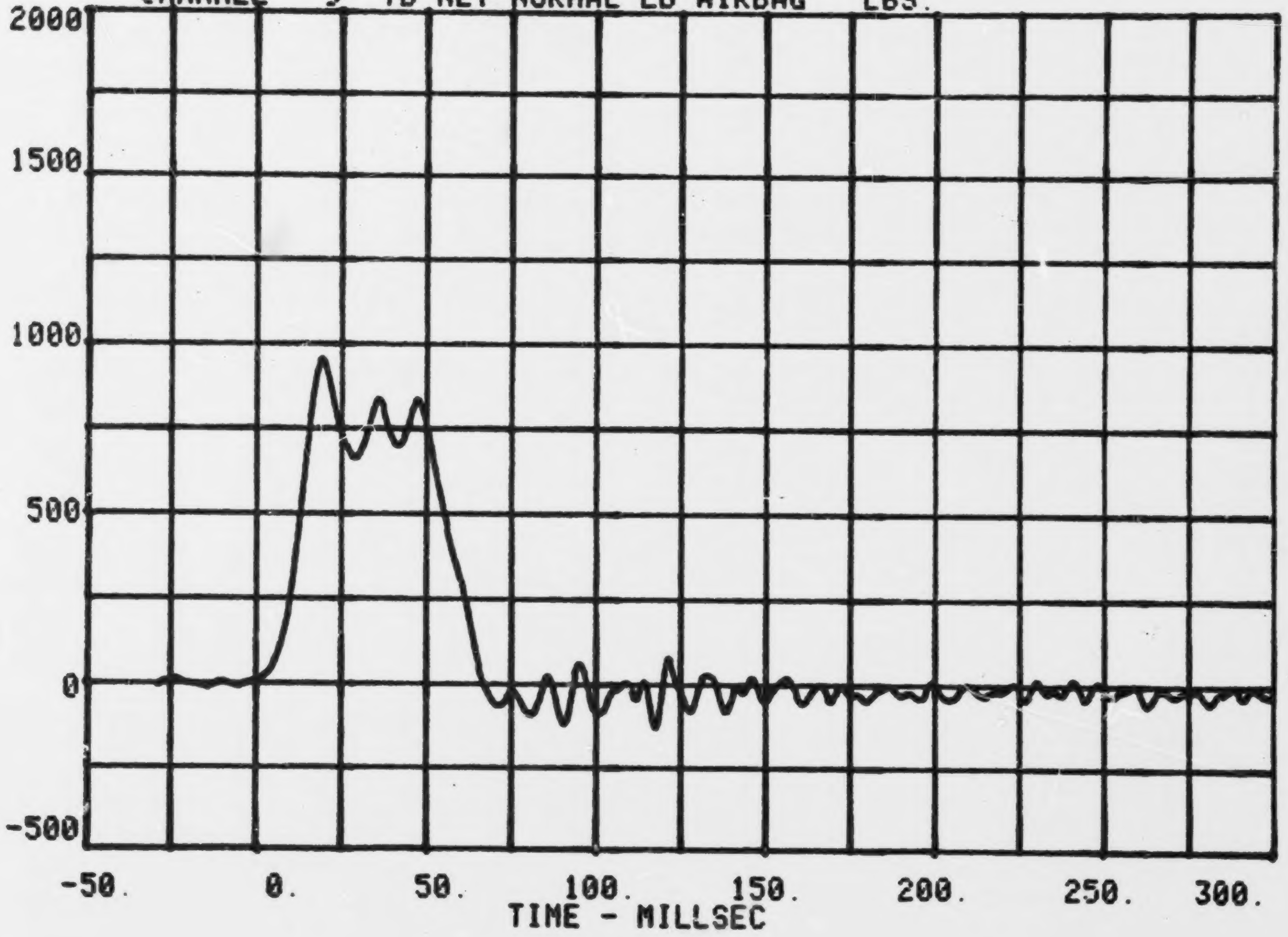


BEST DOCUMENT AVAILABLE



BEST DOCUMENT AVAILABLE

RUN= 2046 SERIES= 2046
CHANNEL 9 TB NET NORMAL LD AIRBAG LBS.

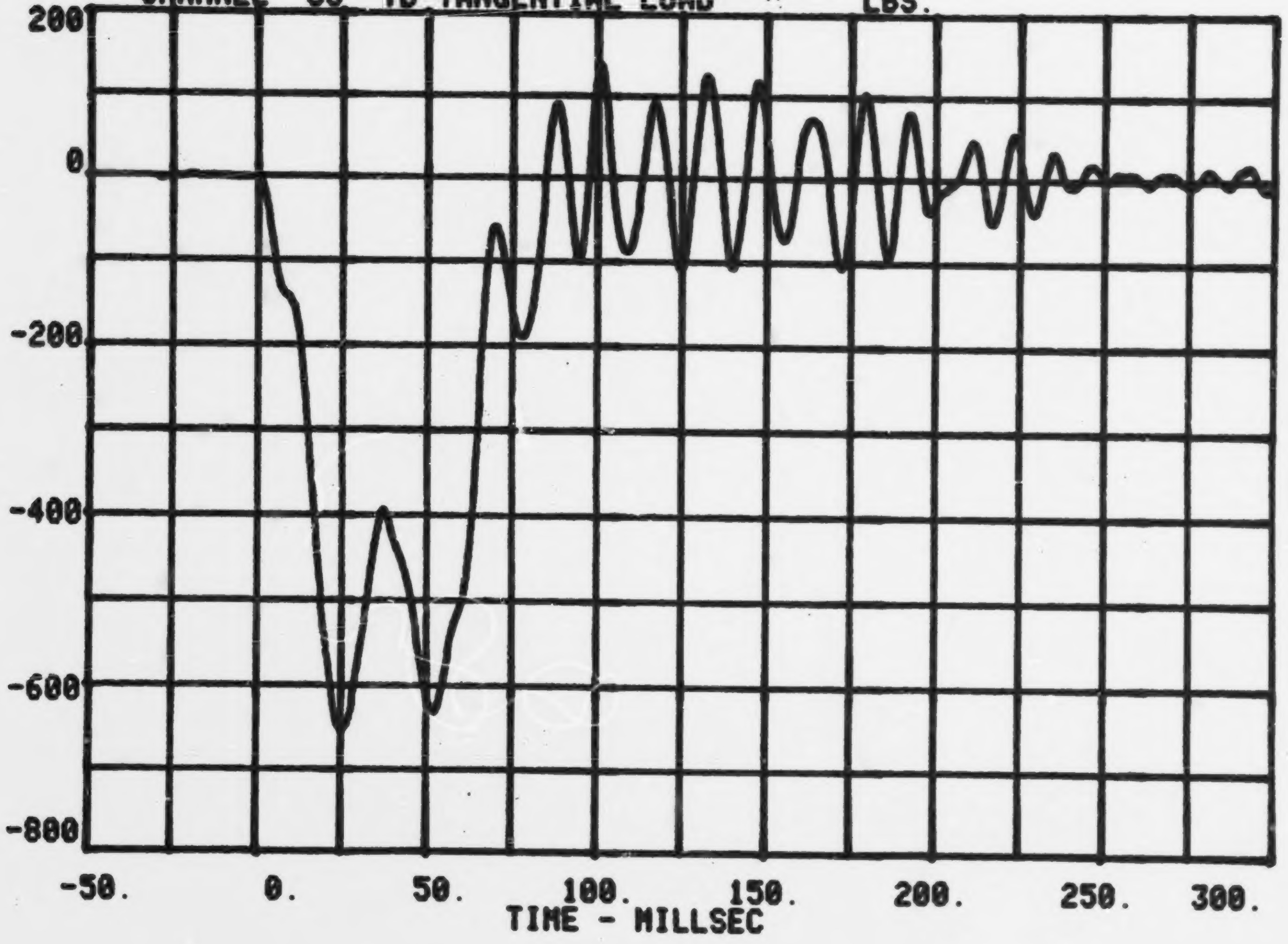


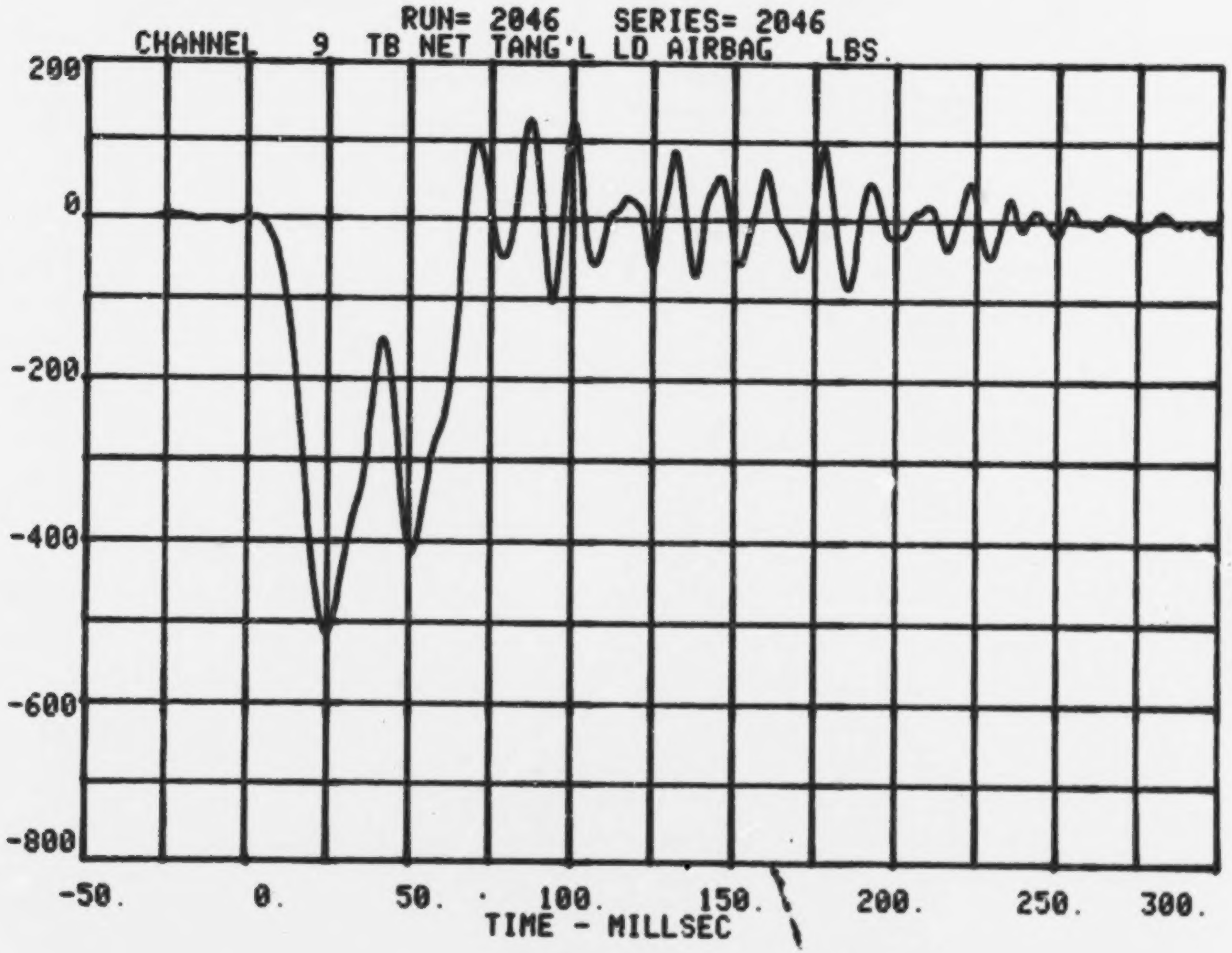
BEST DOCUMENT AVAILABLE

242

RUN= 2046   SERIES= 2046

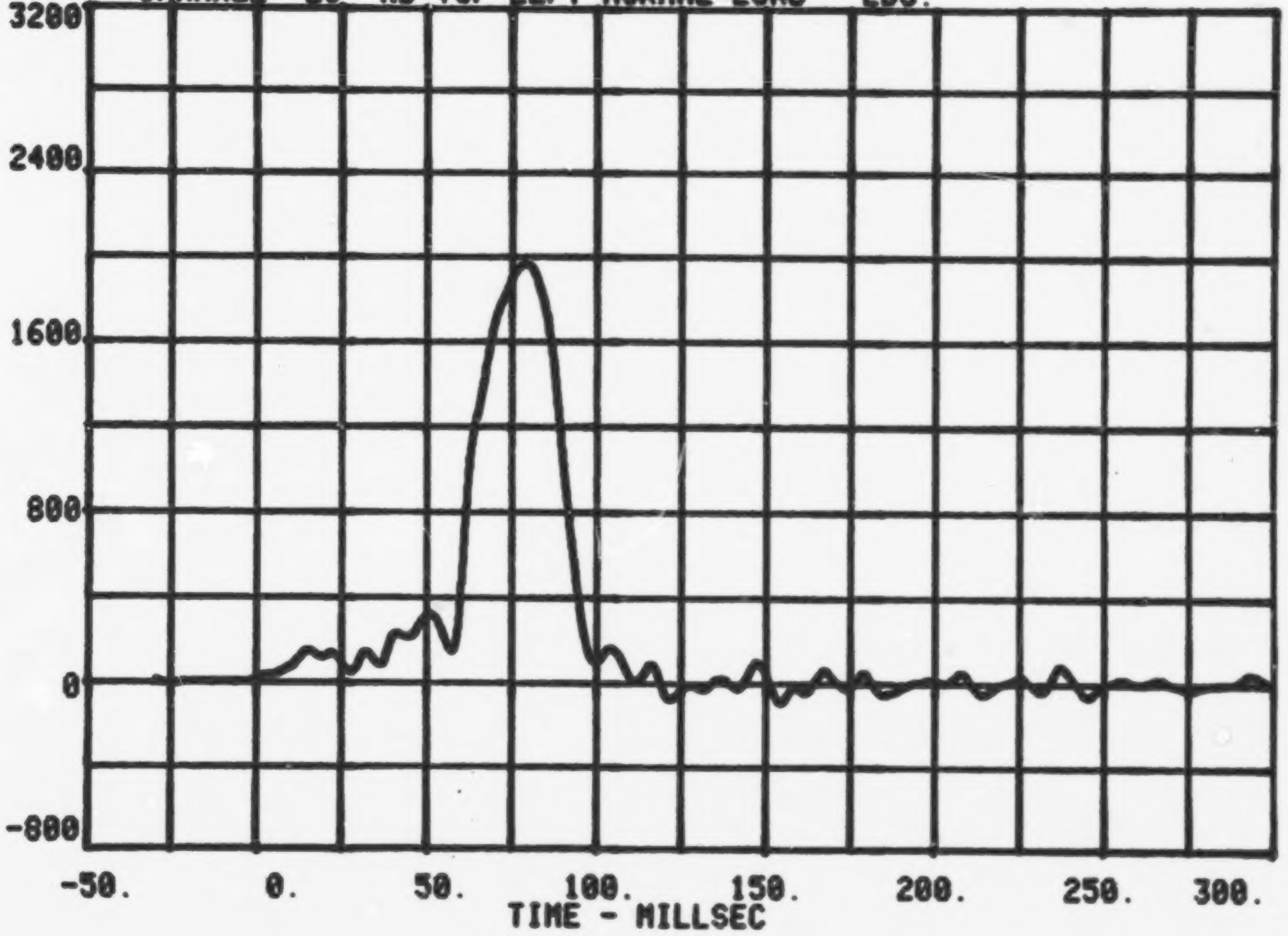
CHANNEL 38 TB TANGENTIAL LOAD   LBS.



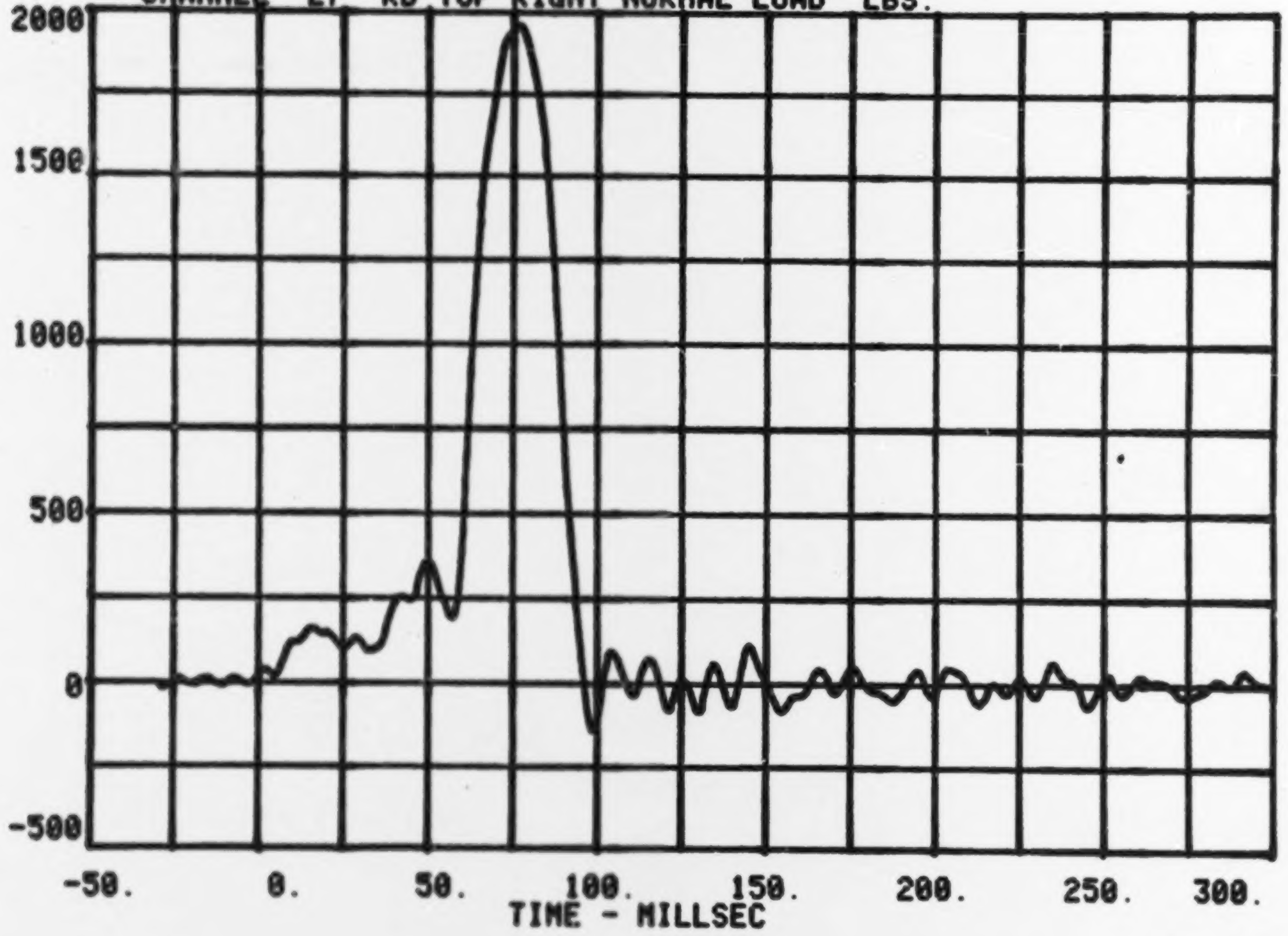

RUN= 2046 SERIES= 2046
CHANNEL 9 TB NET TANG'L LD AIRBAG LBS.
200
0
-200
-400
-600
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

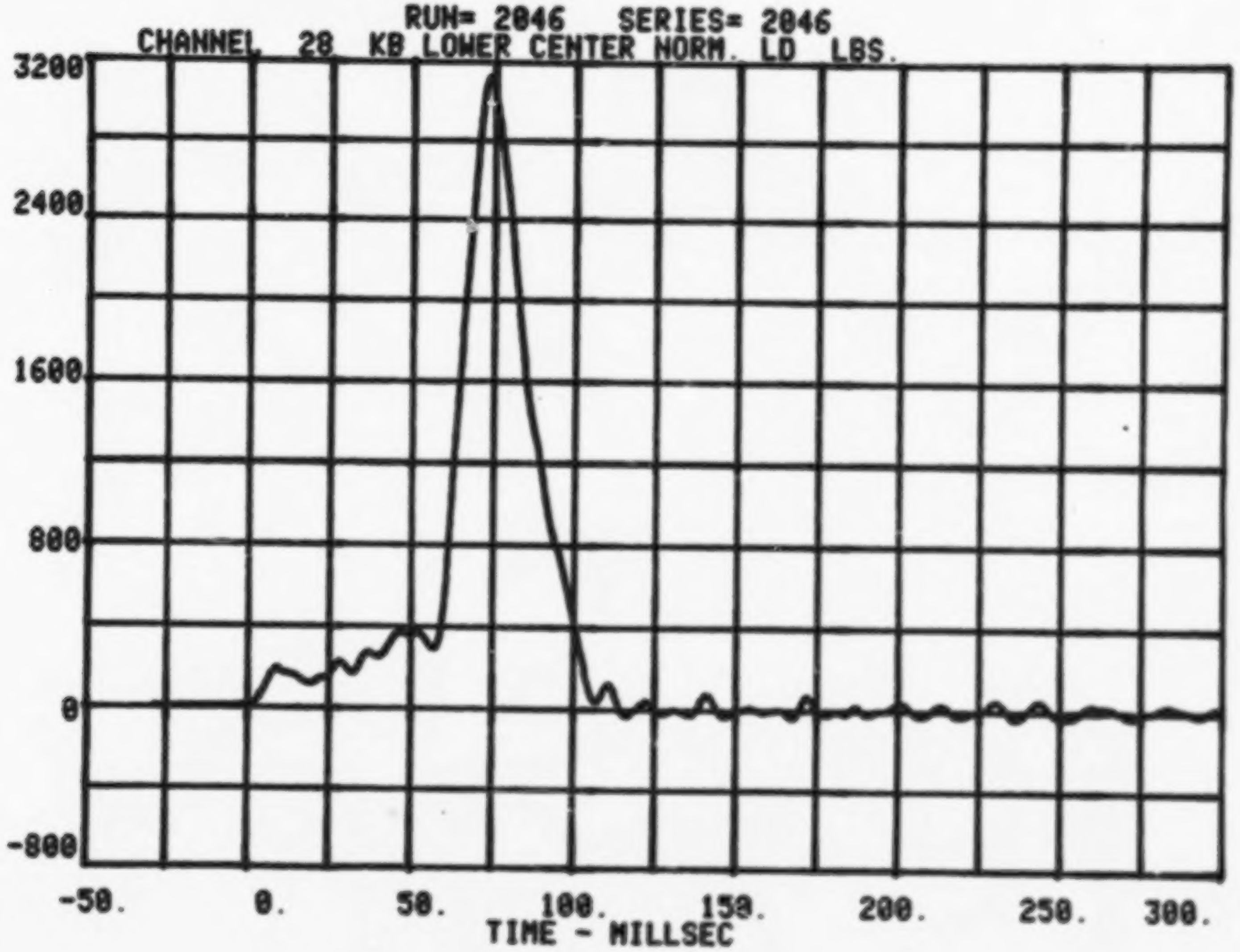
RUN= 2046 SERIES= 2046

CHANNEL 26 KB TOP LEFT NORMAL LOAD LBS.



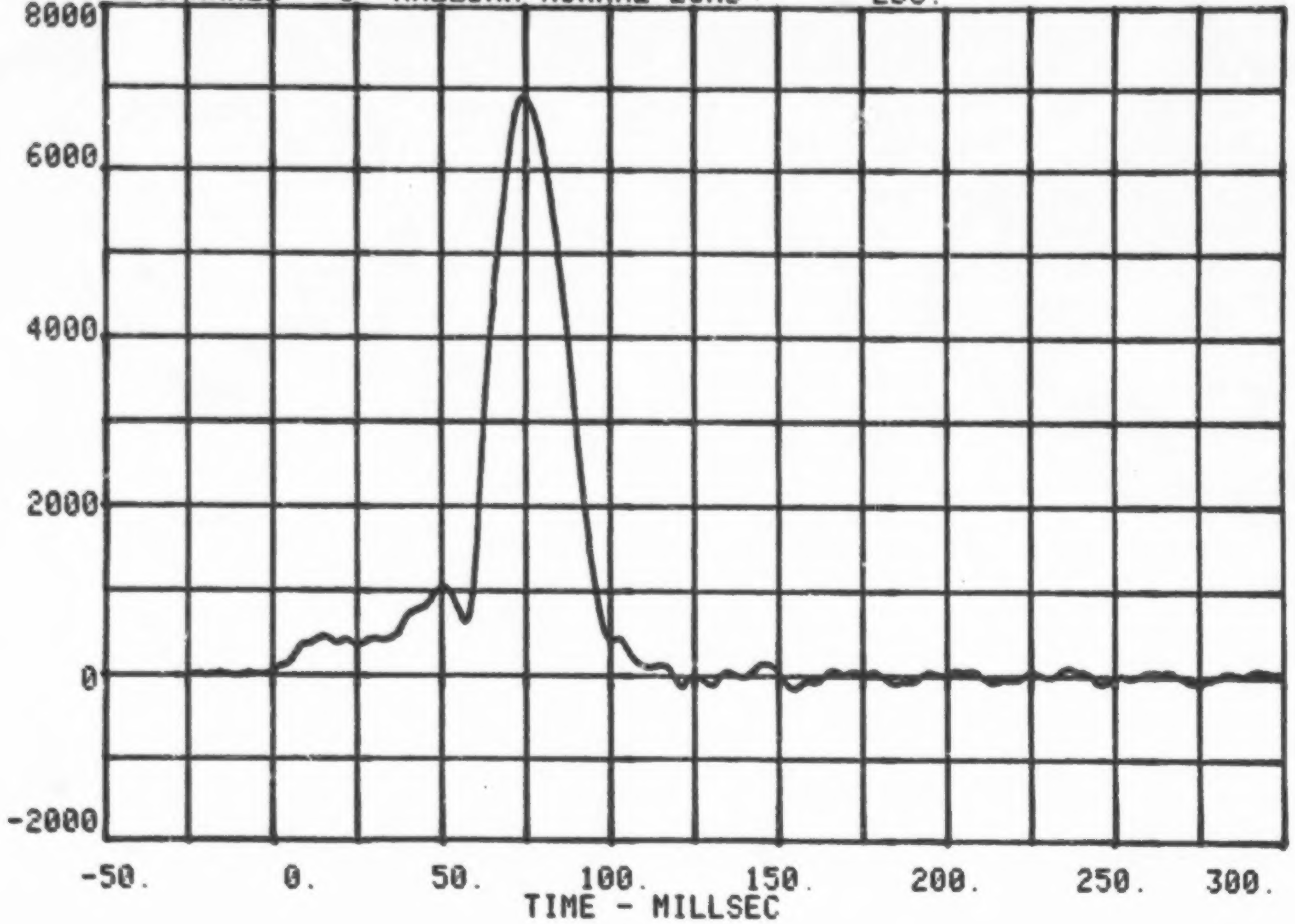
RUN= 2046 SERIES= 2046
CHANNEL 27 KB TOP RIGHT NORMAL LOAD LBS.

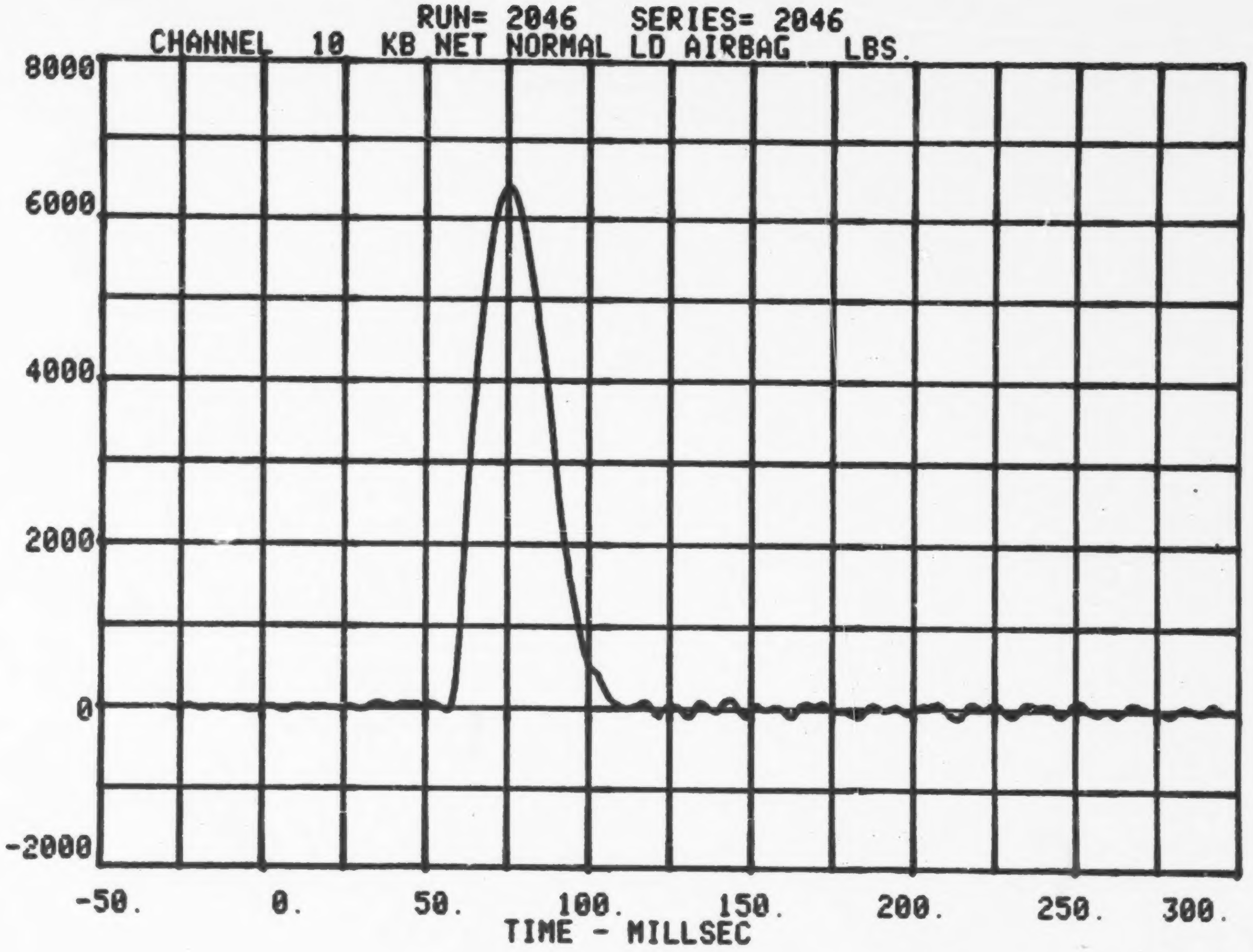



RUN= 2046 SERIES= 2046
CHANNEL 28 KB LOWER CENTER NORM. LD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

RUN= 2046 SERIES= 2046

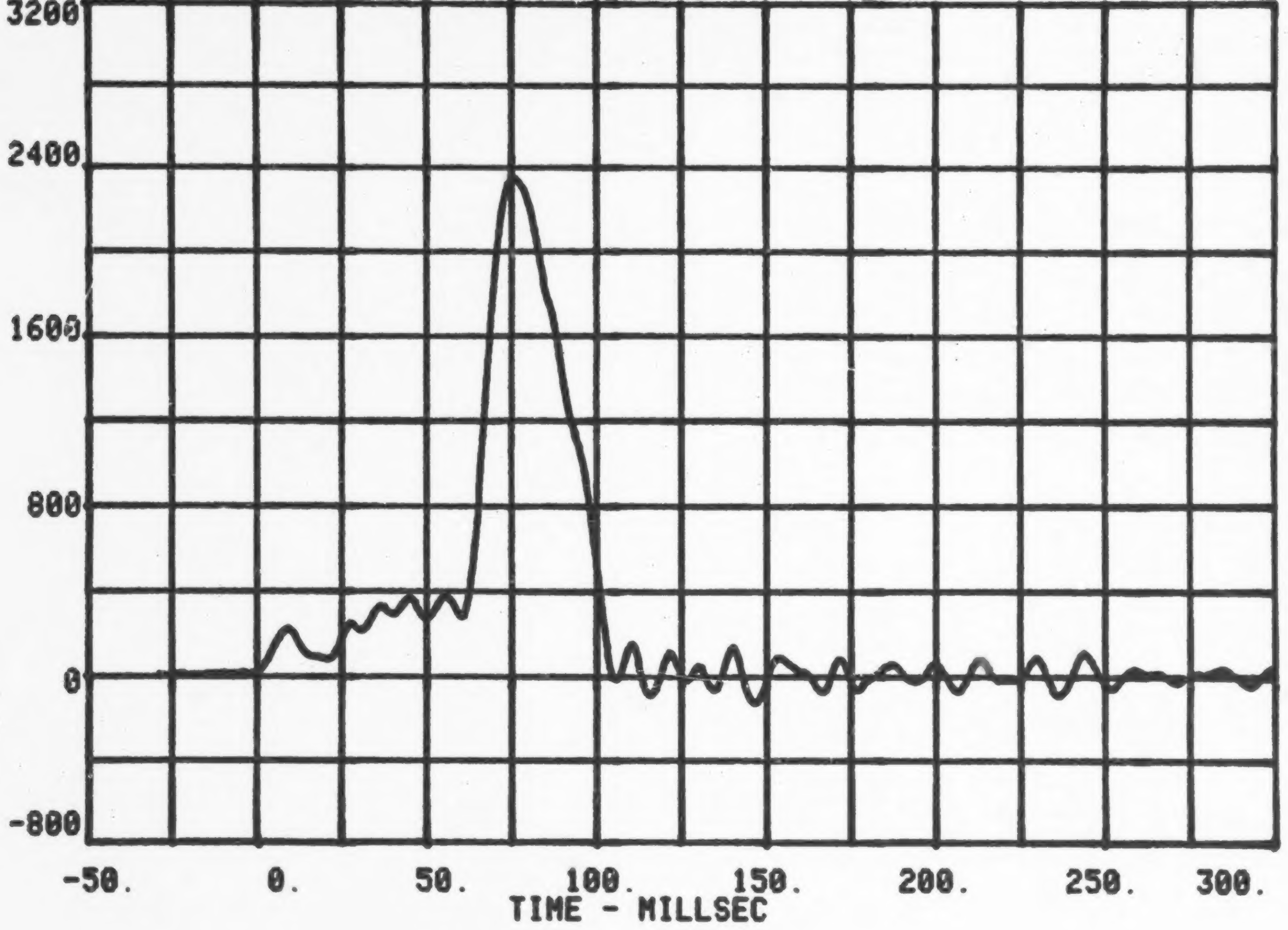
CHANNEL 6 KNEEBAR NORMAL LOAD LBS.

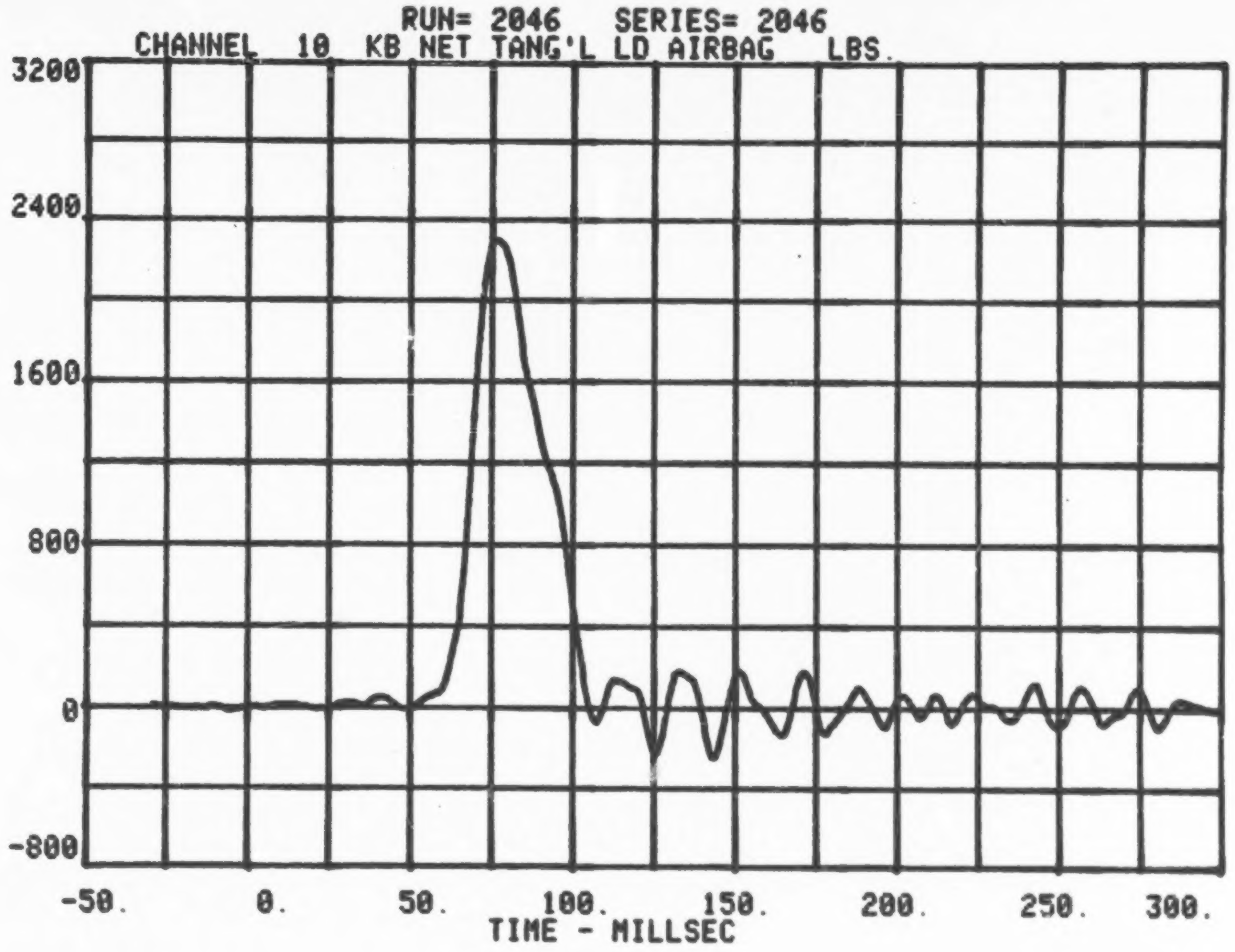


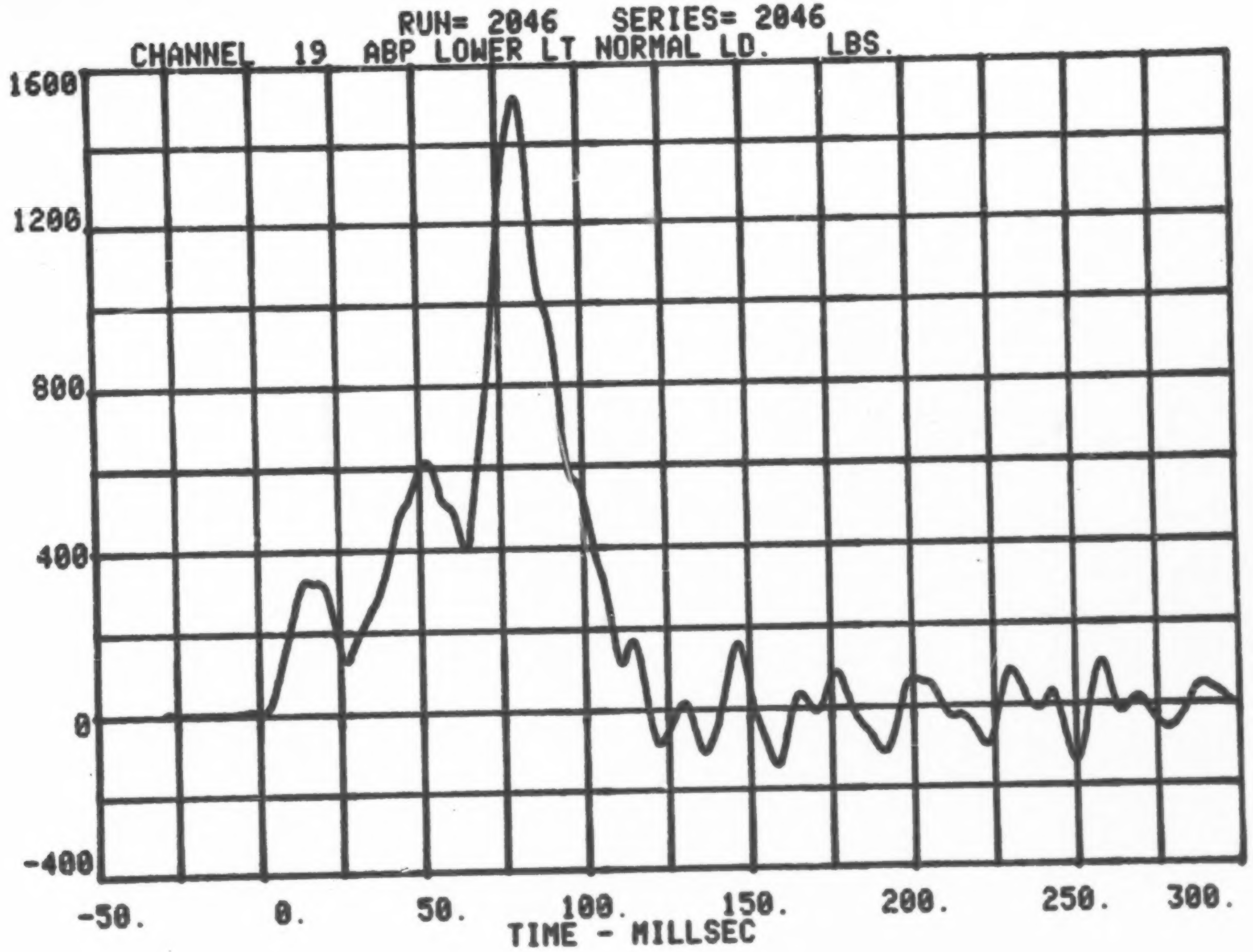

RUN= 2046 SERIES= 2046
CHANNEL 10 KB NET NORMAL LD AIRBAG LBS.
8000
6000
4000
2000
0
-2000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

RUN= 2046 SERIES= 2046

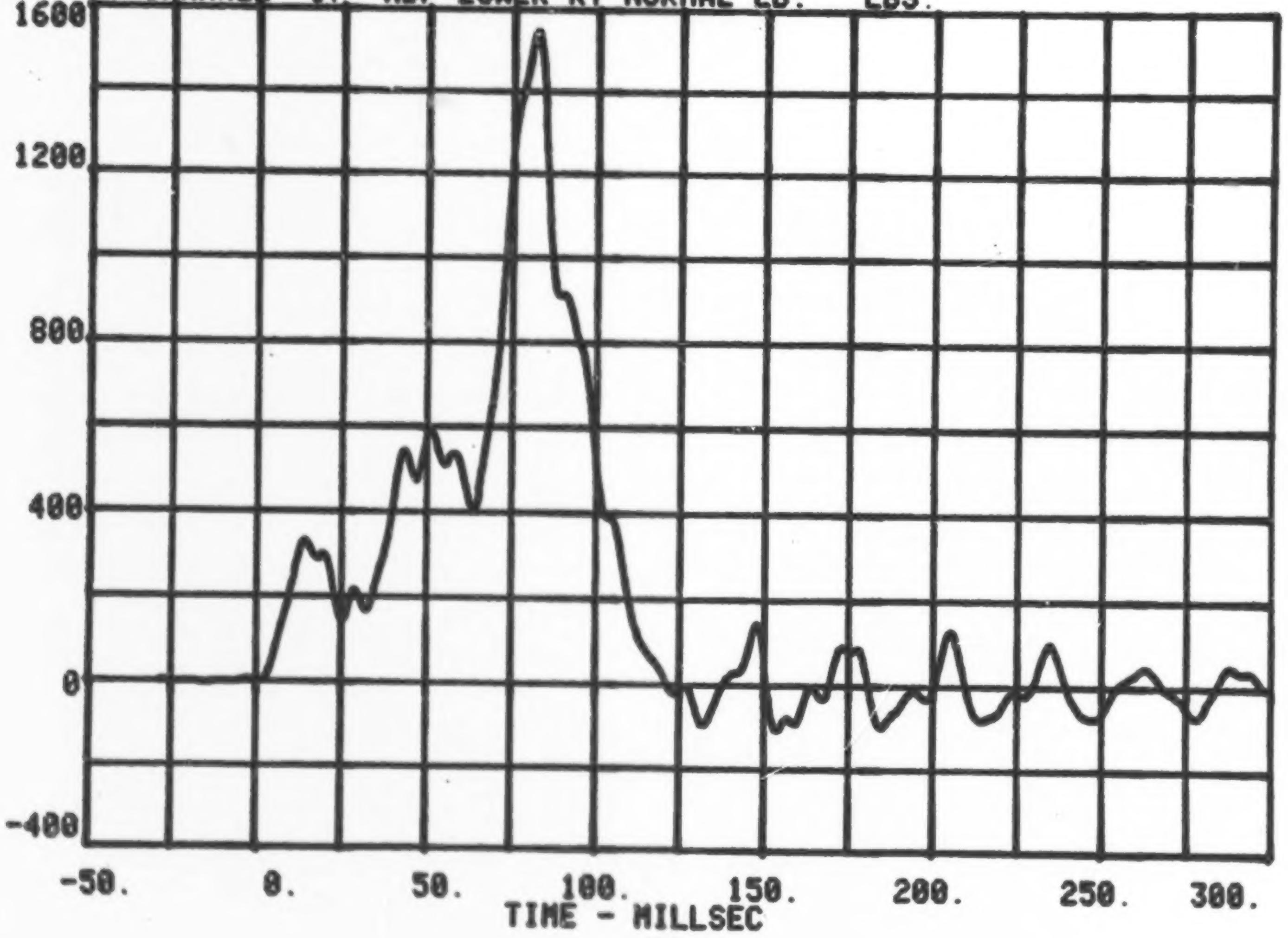
CHANNEL 29 KB TANGENTIAL LOAD LBS.



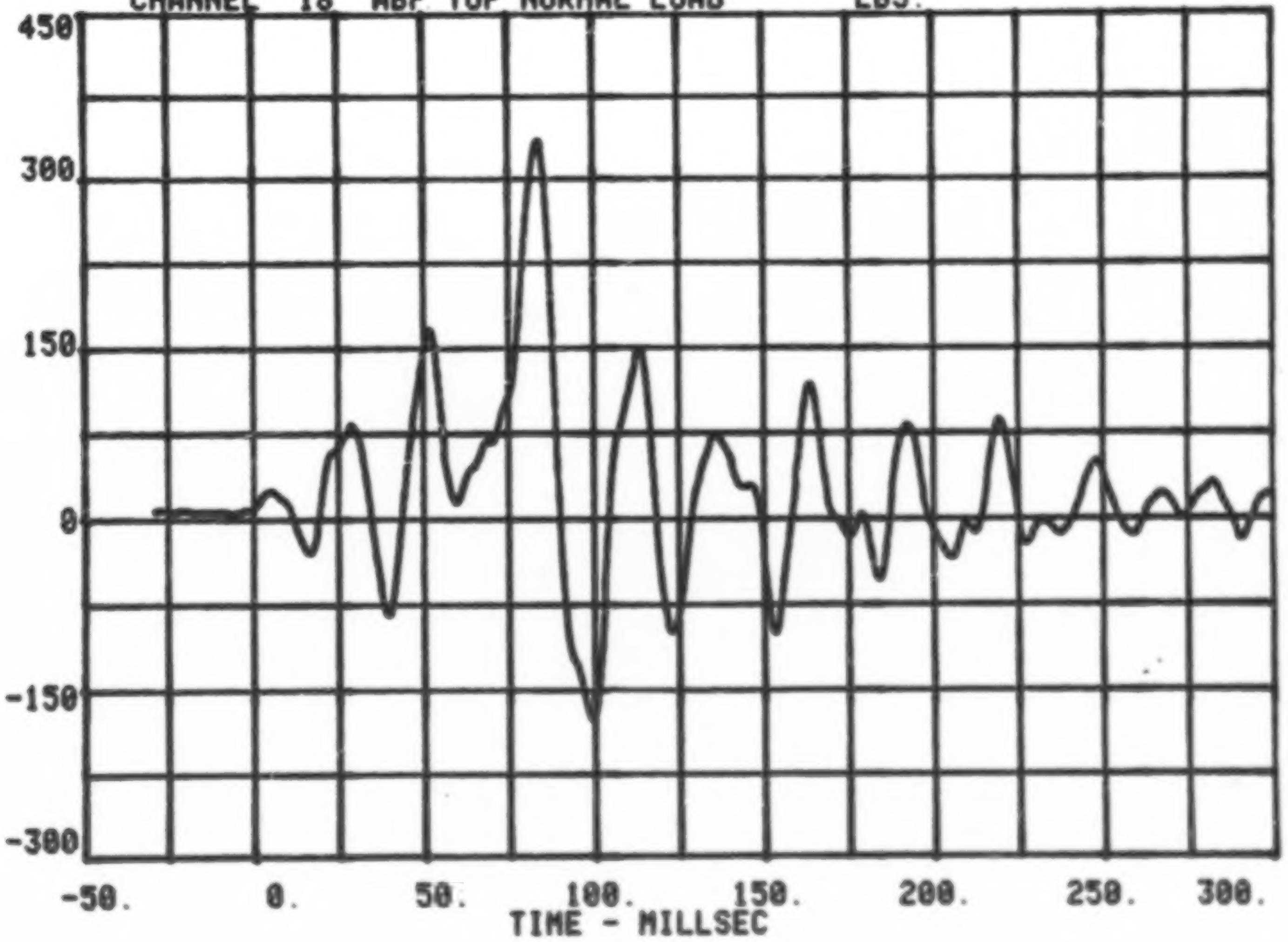

RUN= 2046 SERIES= 2046
CHANNEL 10 KB NET TANG'L LD AIRBAG LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



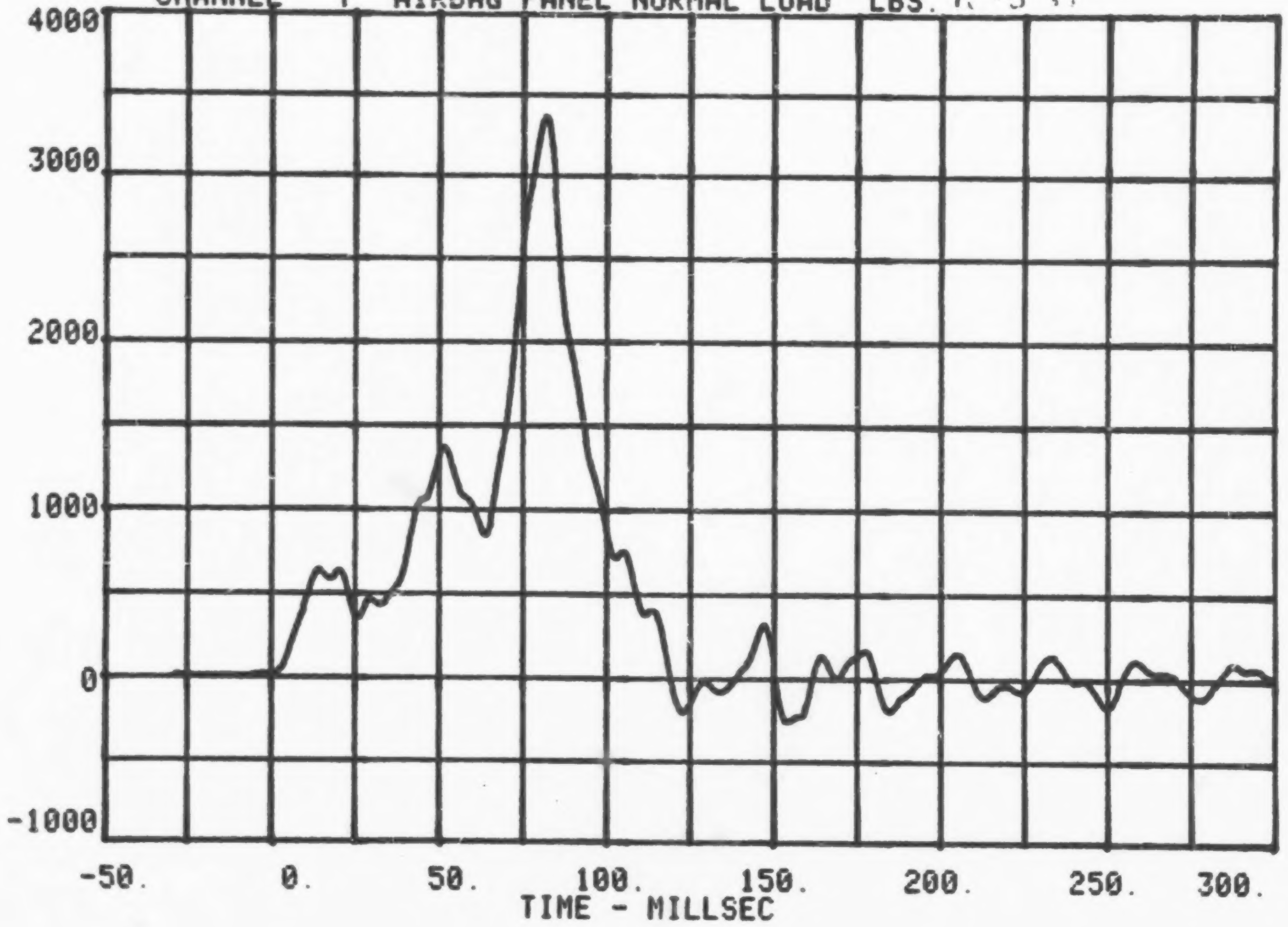
BEST DOCUMENT AVAILABLE

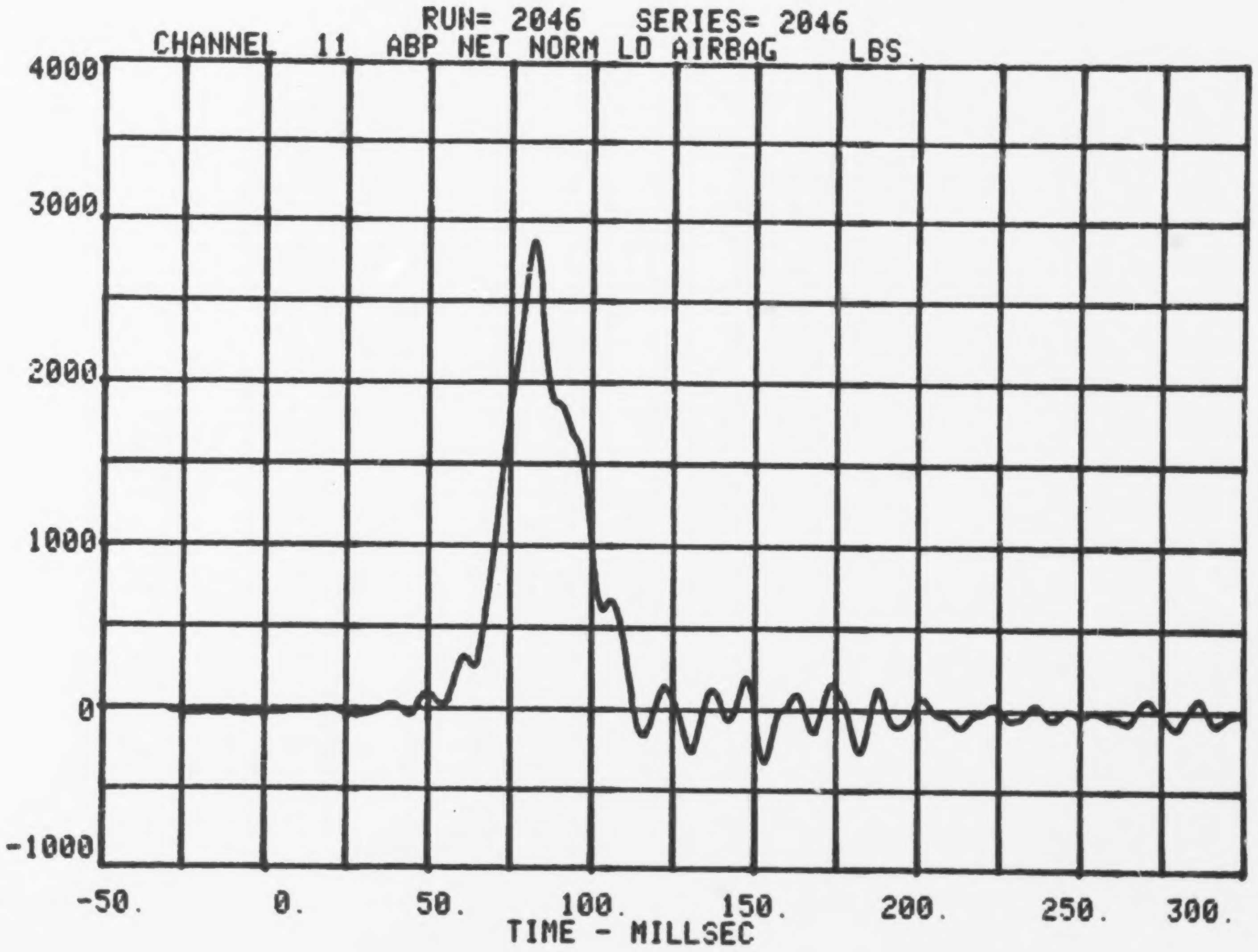

RUN= 2046 SERIES= 2046
CHANNEL 17 ABP LOWER RT NORMAL LD. LBS.

RUN= 2046 SERIES= 2046
CHANNEL 18 ABP TOP NORMAL LOAD LBS.

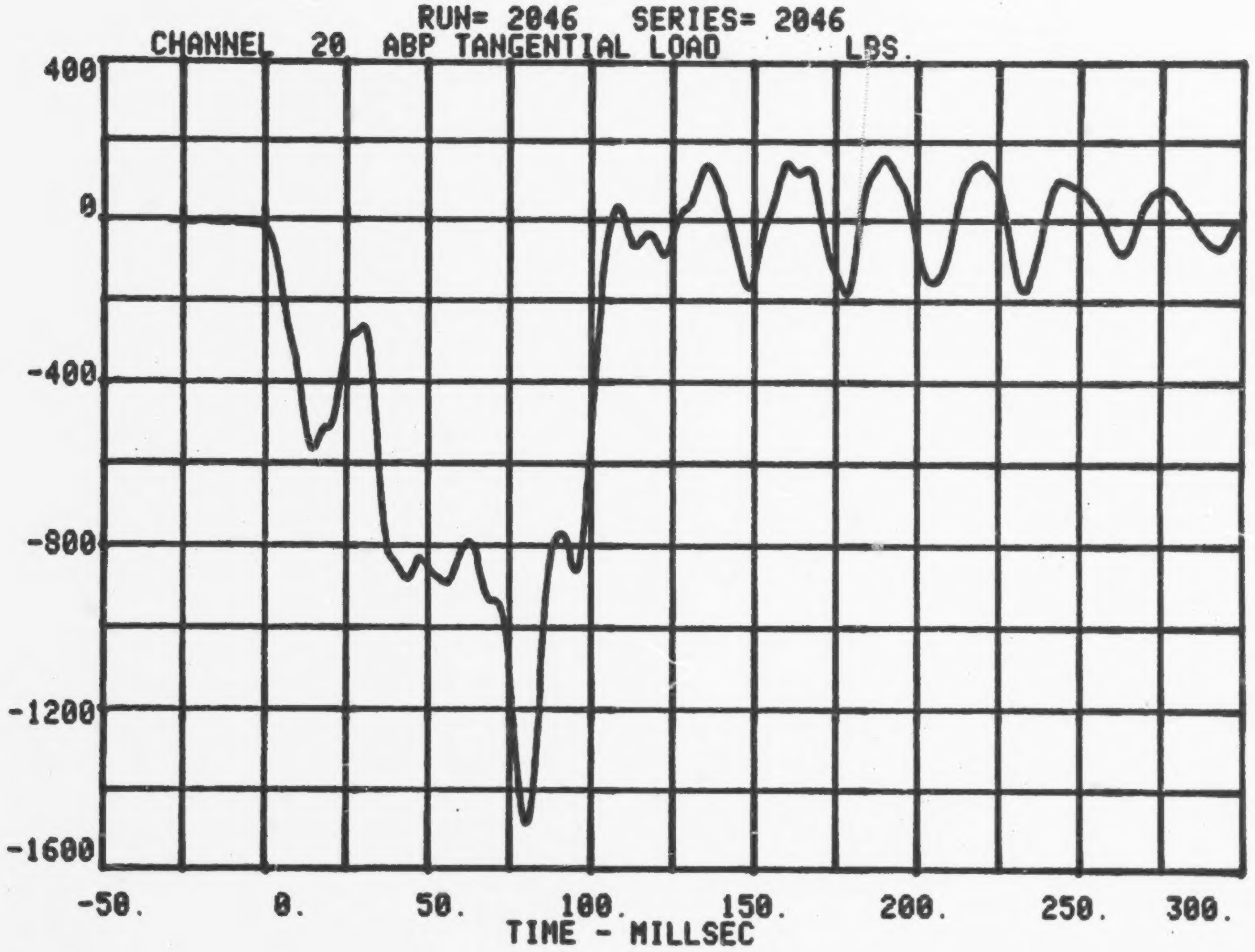


RUN= 2046 SERIES= 2046
CHANNEL 7 AIRBAG PANEL NORMAL LOAD LBS.

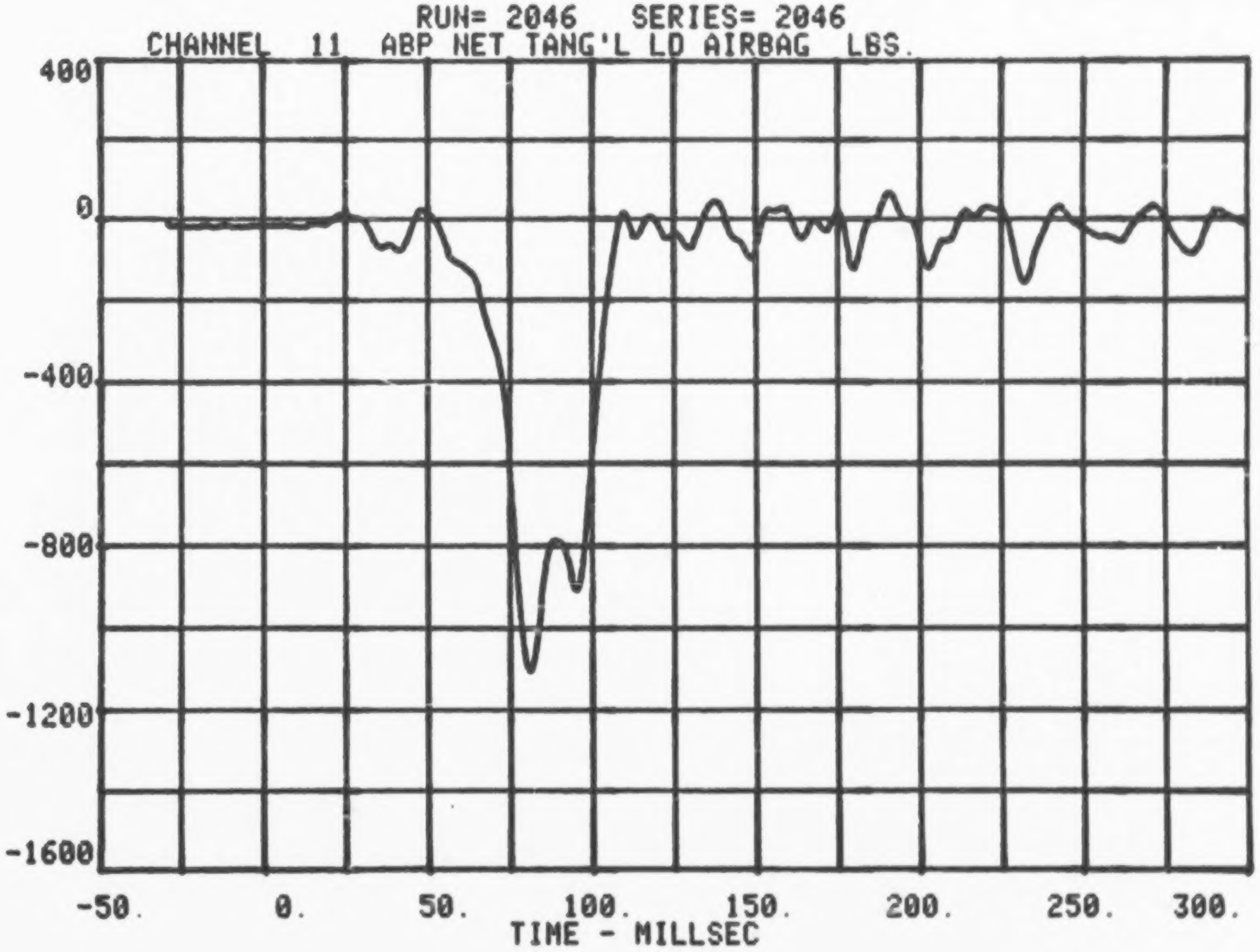




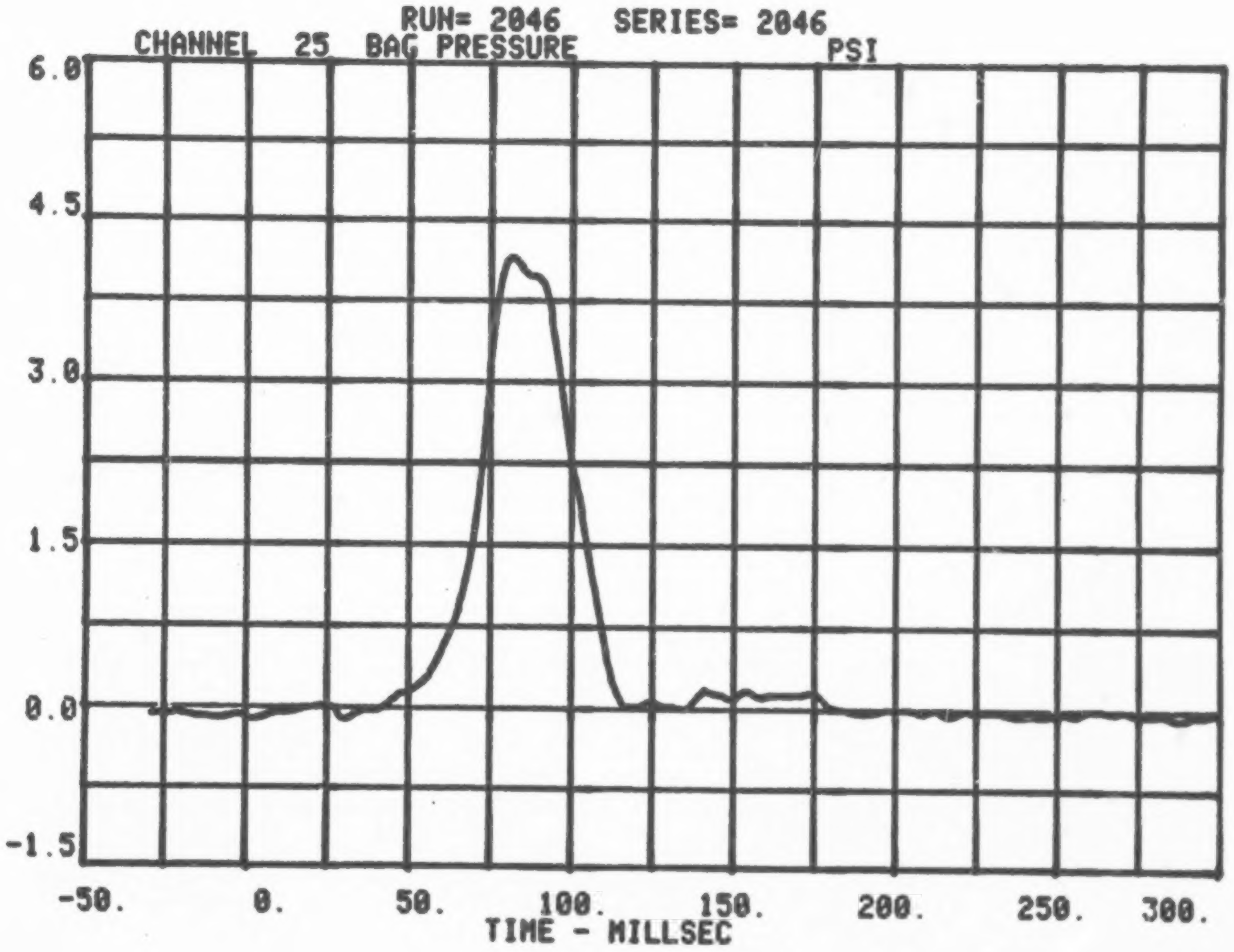
BEST DOCUMENT AVAILABLE

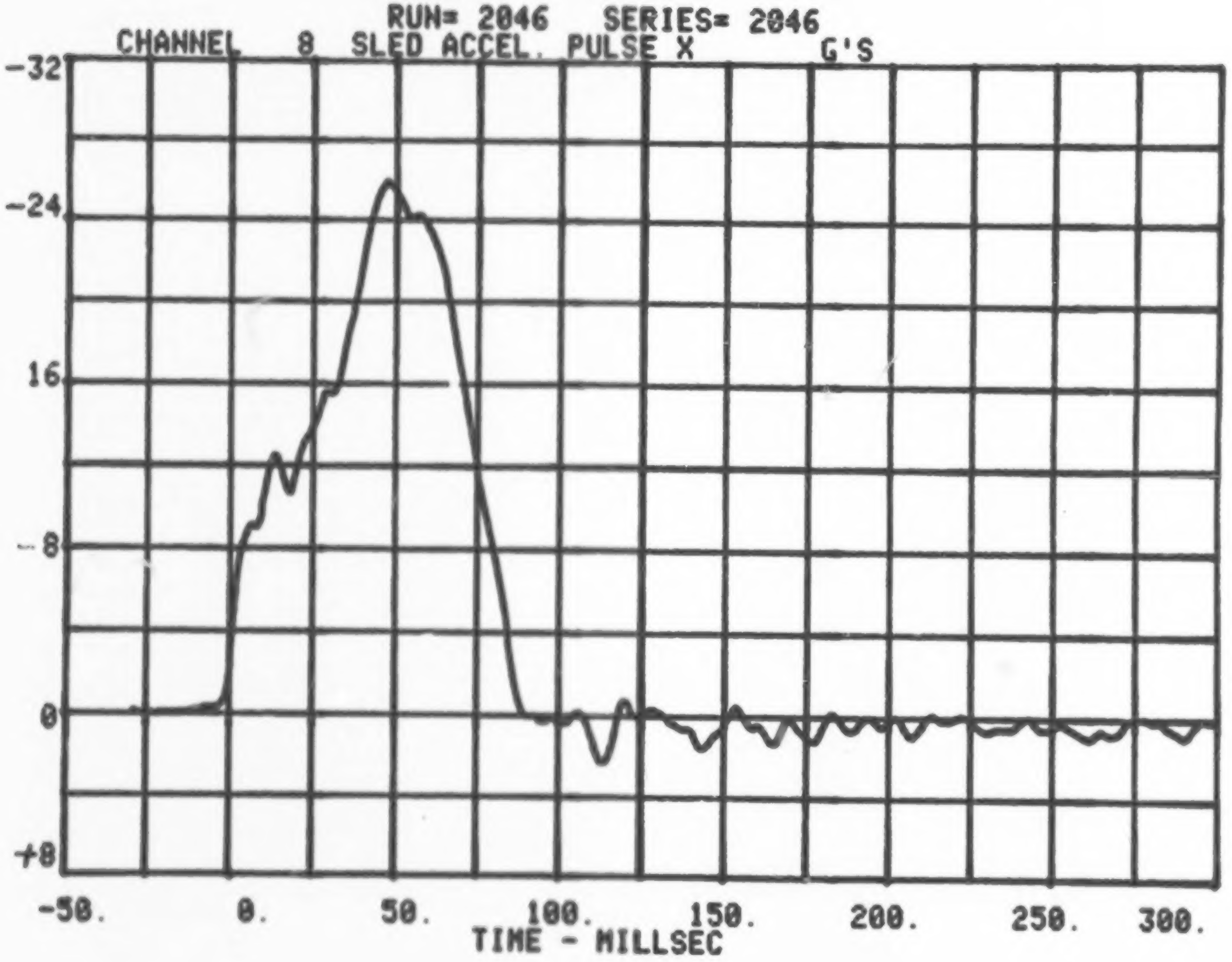


BEST DOCUMENT AVAILABLE



BEST DOCUMENT AVAILABLE


RUN= 2046 SERIES= 2046
CHANNEL 25 BAG PRESSURE
PSI
6.0
4.5
3.0
1.5
0.0
-1.5
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2046 SERIES= 2046
CHANNEL 8 SLED ACCEL. PULSE X G'S
-32
-24
16
8
0
+8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

APPENDIX F

BELT RESTRAINT SLED TEST 2049 DATA RECORDS

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Pelvis Accelerations	180
Arm Accelerations	180
Femur Loads	600
Contact Panel Loads	60
Belt Loads	60
Belt Elongations	180
Load Limiter Strokes	180
Sled Acceleration	60

Sequence of Data Records

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Pelvis - X, Y, Z, Resultant Accelerations

Left Arm - X, Y, Z, Resultant Accelerations

Right Arm - X, Y, Z, Resultant Accelerations

Seat Normal Load - Front Left, Front Right, Rear, Gross Sum, Net Sum

Seat Tangential Load - Gross, Net

Toeboard Normal Load - Lower Left, Lower Right, Upper Center,
Gross Sum, Net Sum

Toeboard Tangential Load - Gross, Net

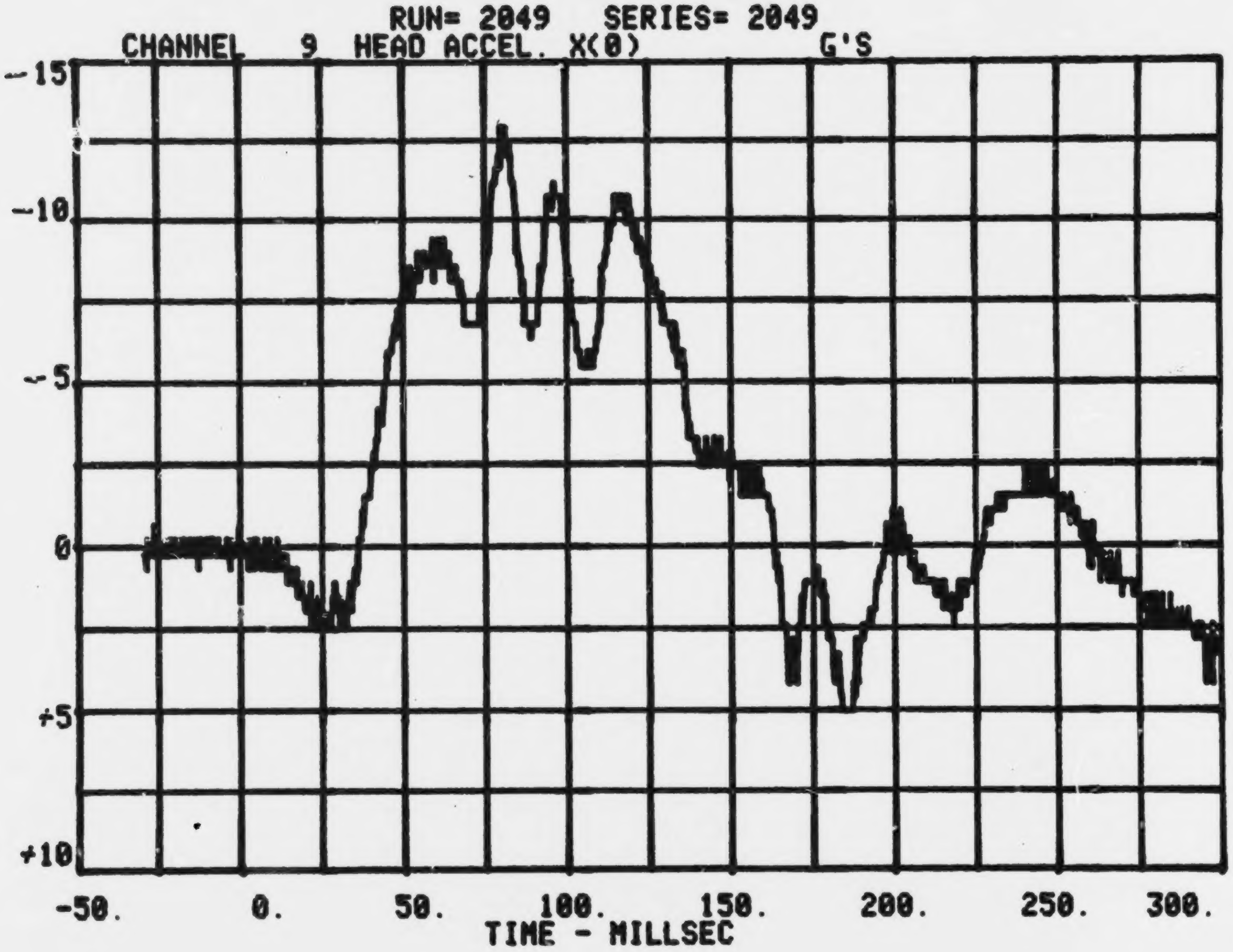
Belt Load - Left Lap, Right Lap, Shoulder

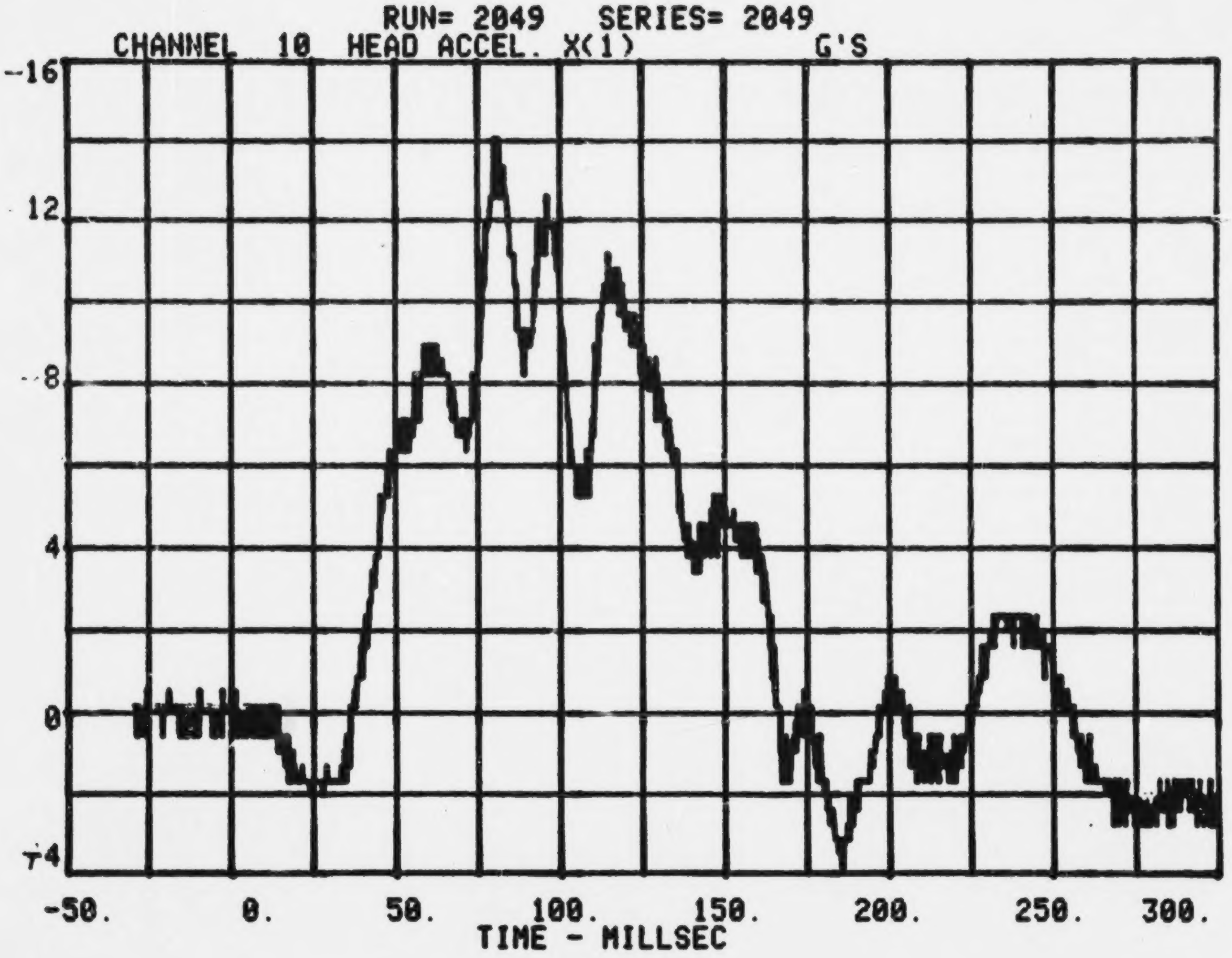
Belt Elongation - Lap, Shoulder

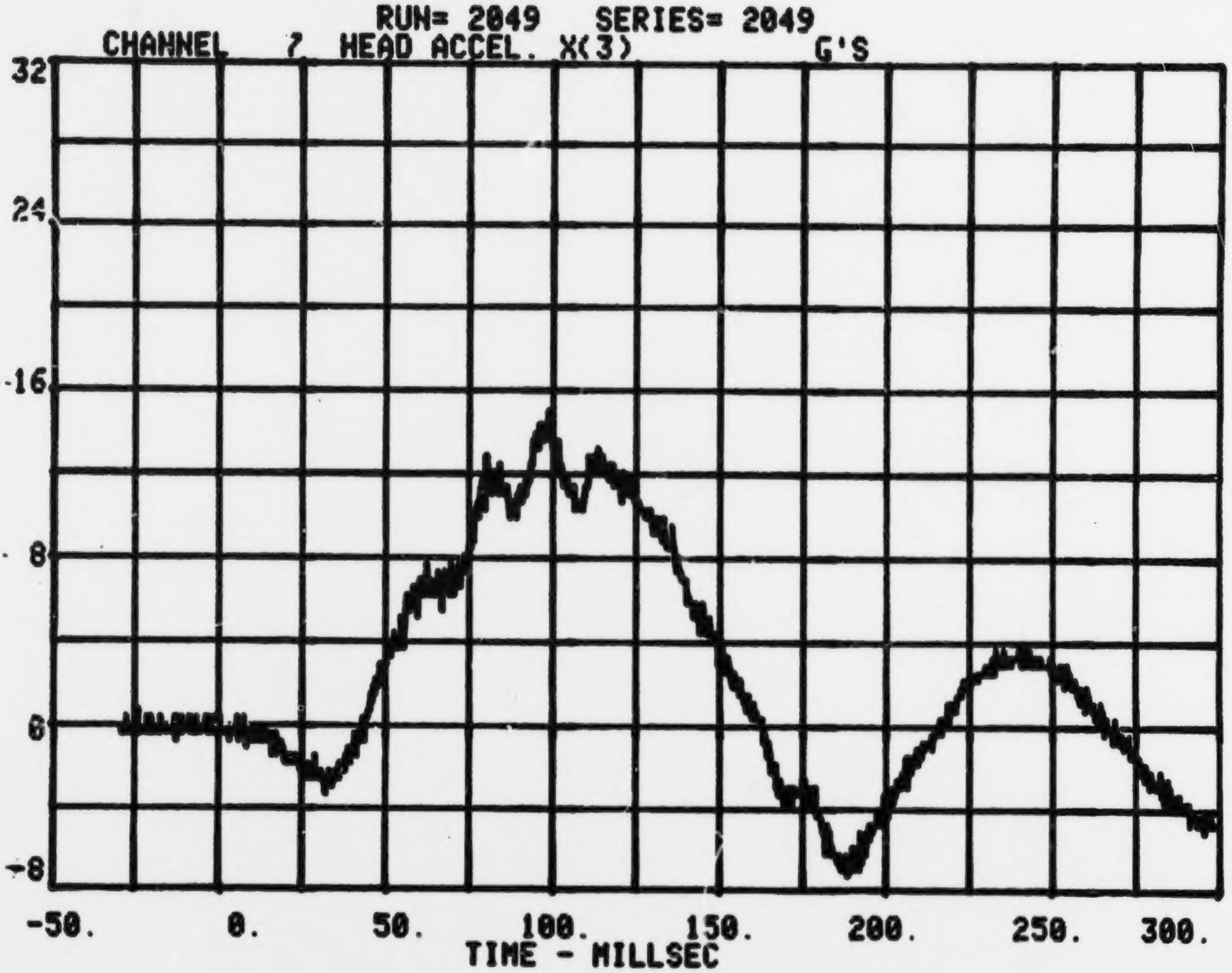
Belt Load Limiter Stroke - Left Lap, Right Lap, Shoulder

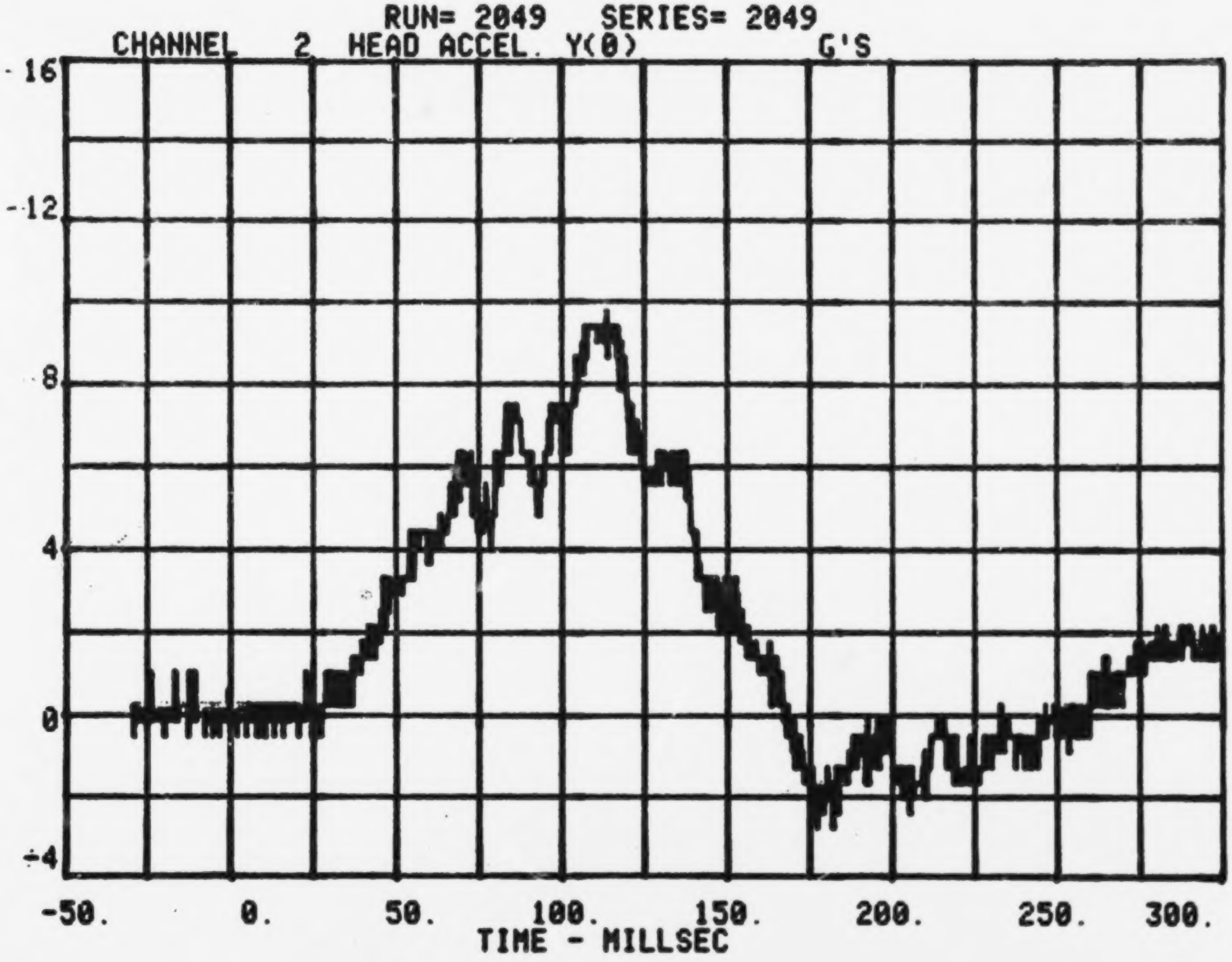
Sled Acceleration

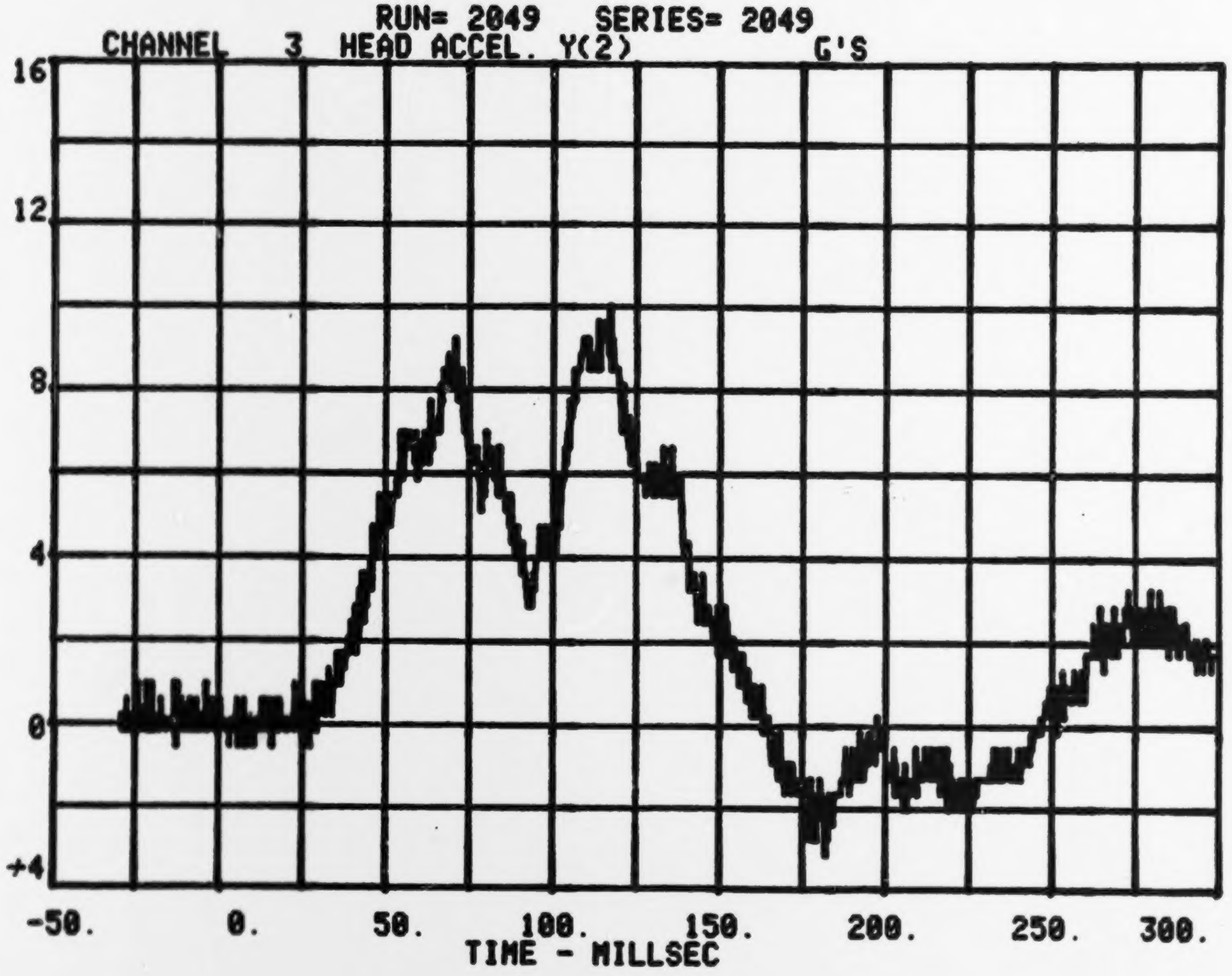
```
                    HEAD INJURY CRITERION
                     HEAD SEVERITY INDEX

               SLED TEST #2049

               RUN=2049

               RESULT. HEAD ACCEL.

HIC= 216.0   FROM T1= .04830   TO T2= .12390

AVERAGE ACCELERATION BETWEEN T1 AND T2=  24.1G'S

EVENT TIME= 300.0  MSEC

SEVERITY INDEX= 283.1
```

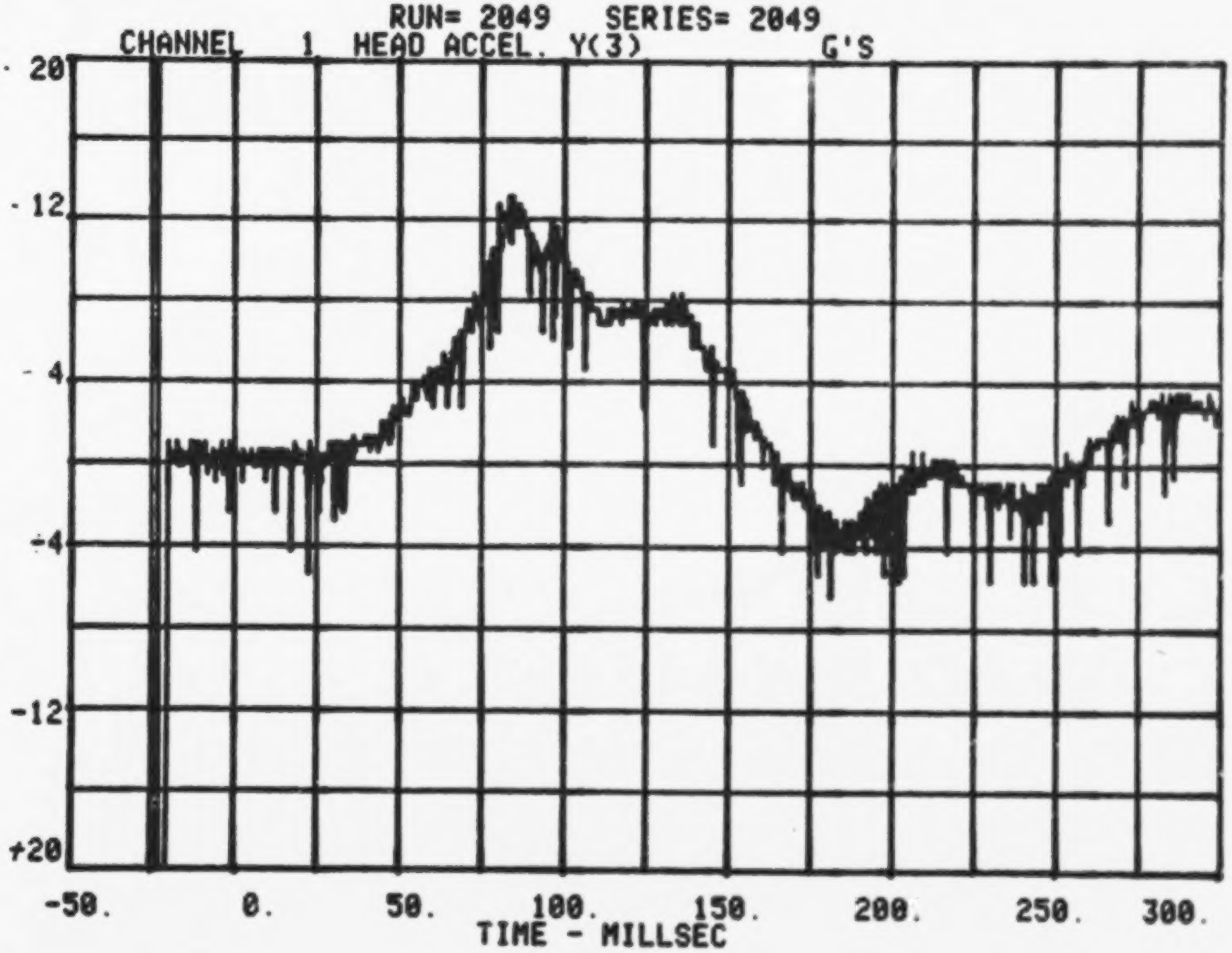

RUN= 2049 SERIES= 2049
CHANNEL 9 HEAD ACCEL. X(0) G'S
-15
-10
-5
0
+5
+10
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

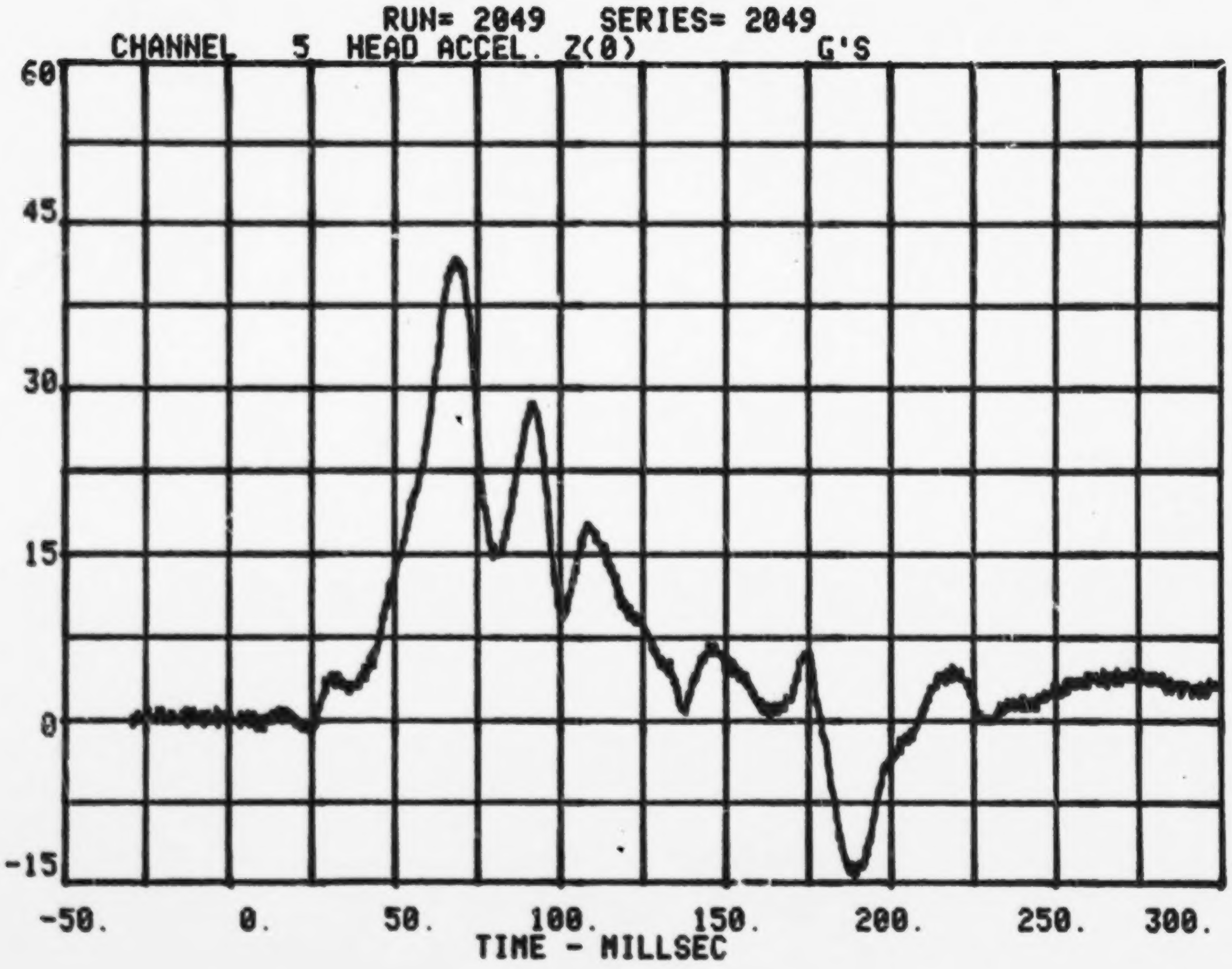

RUN= 2049 SERIES= 2049
CHANNEL 10 HEAD ACCEL. X(1) G'S
-16
12
-8
4
0
-4
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2049 SERIES= 2049
CHANNEL 7 HEAD ACCEL. X(3) G'S
32
24
16
8
0
-8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

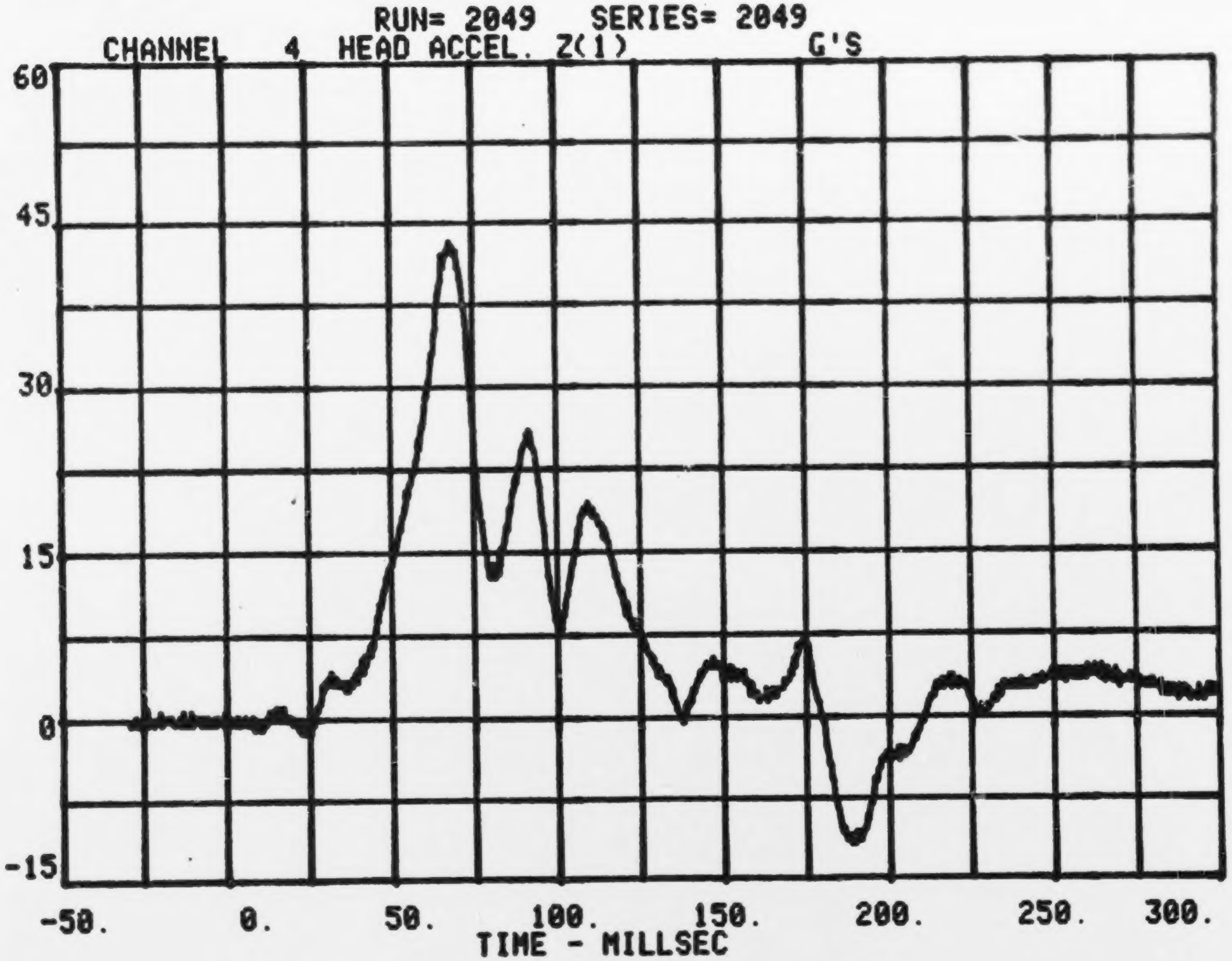

RUN= 2049 SERIES= 2049
CHANNEL 2 HEAD ACCEL. Y(0) G'S
16
12
8
4
0
-4
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

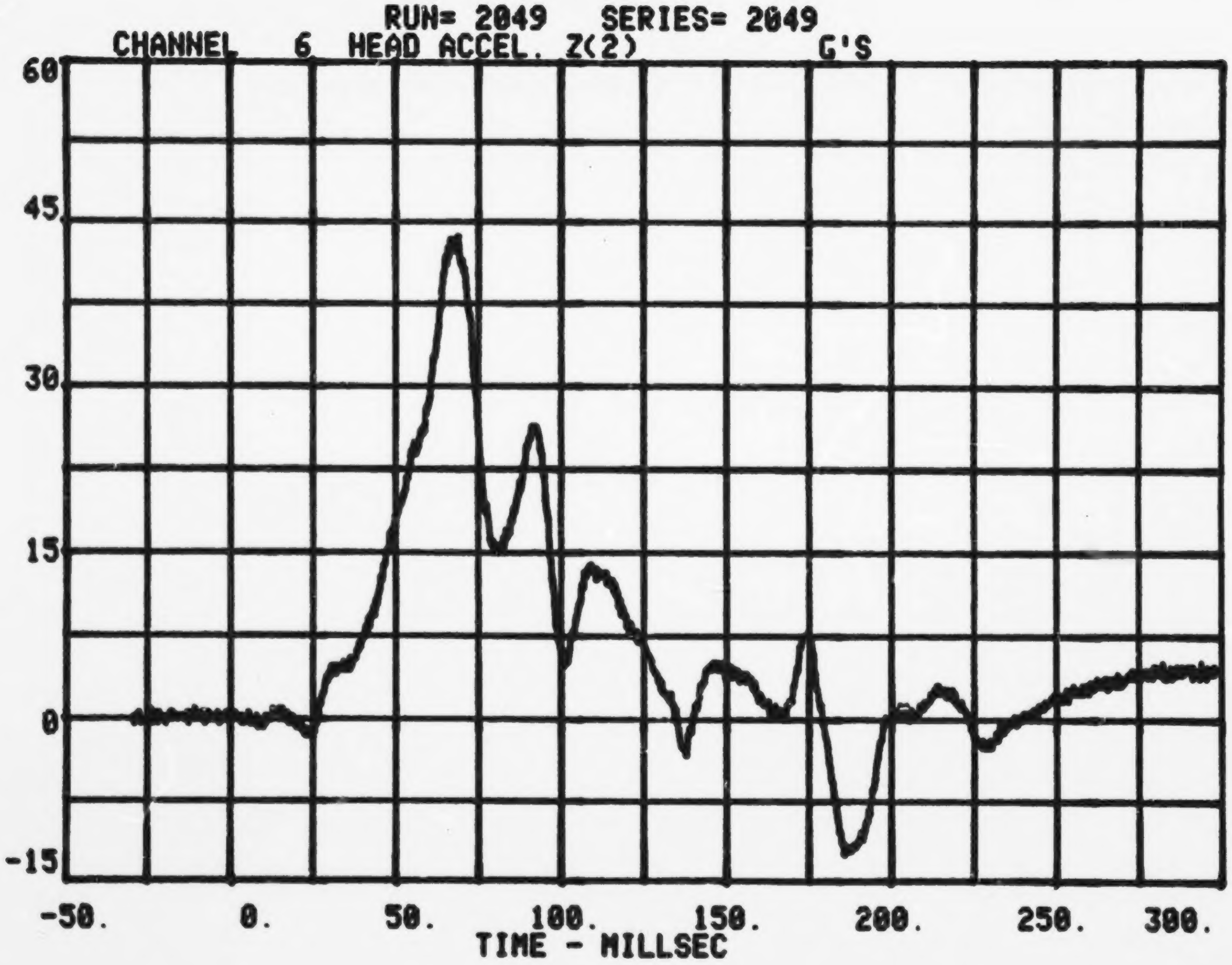

RUN= 2049 SERIES= 2049
CHANNEL 3 HEAD ACCEL. Y(2) G'S
16
12
8
4
0
+4
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2049 SERIES= 2049
CHANNEL 1 HEAD ACCEL. Y(3) G'S
20
12
4
-4
-12
-20
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

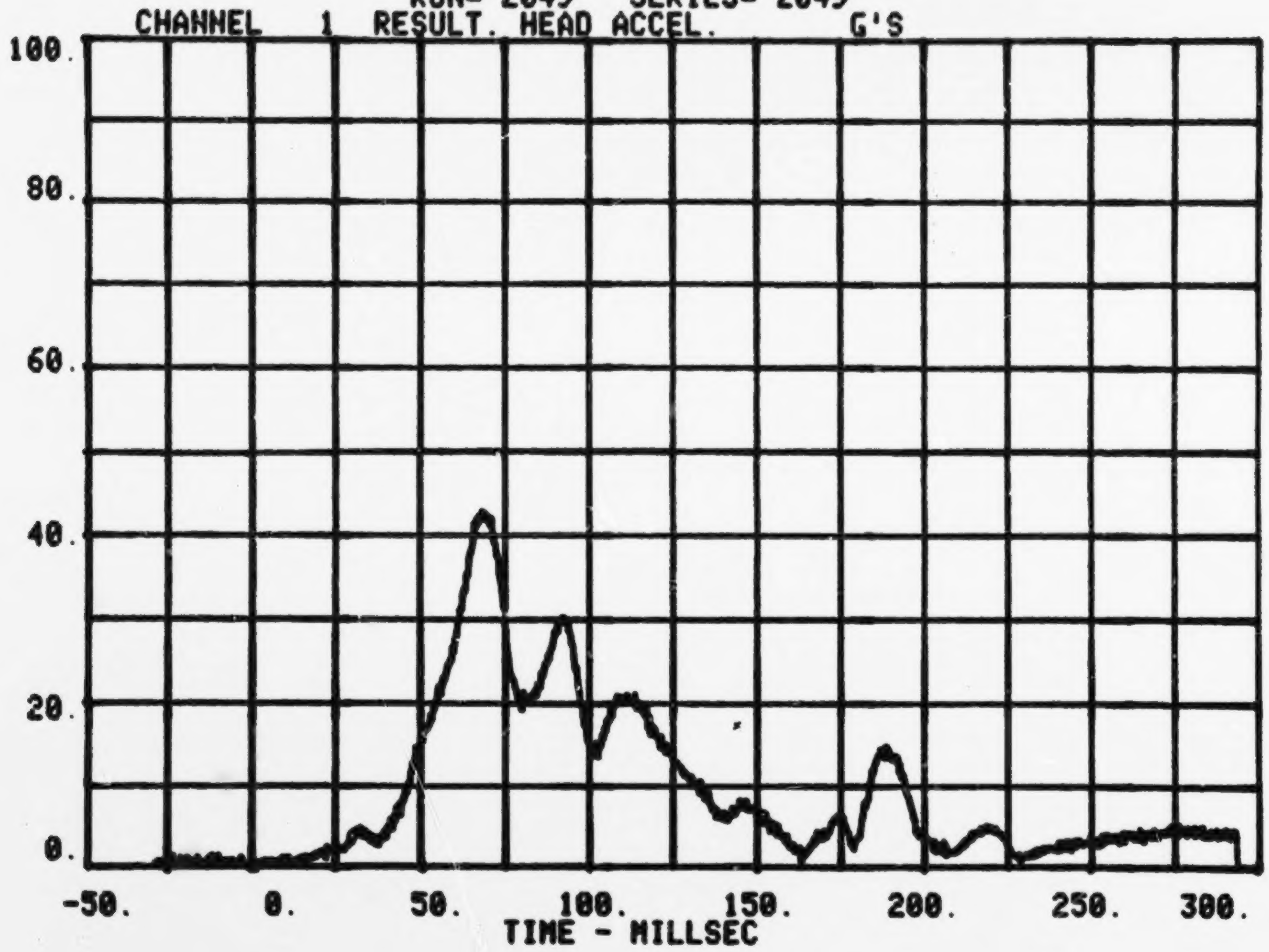


BEST DOCUMENT AVAILABLE

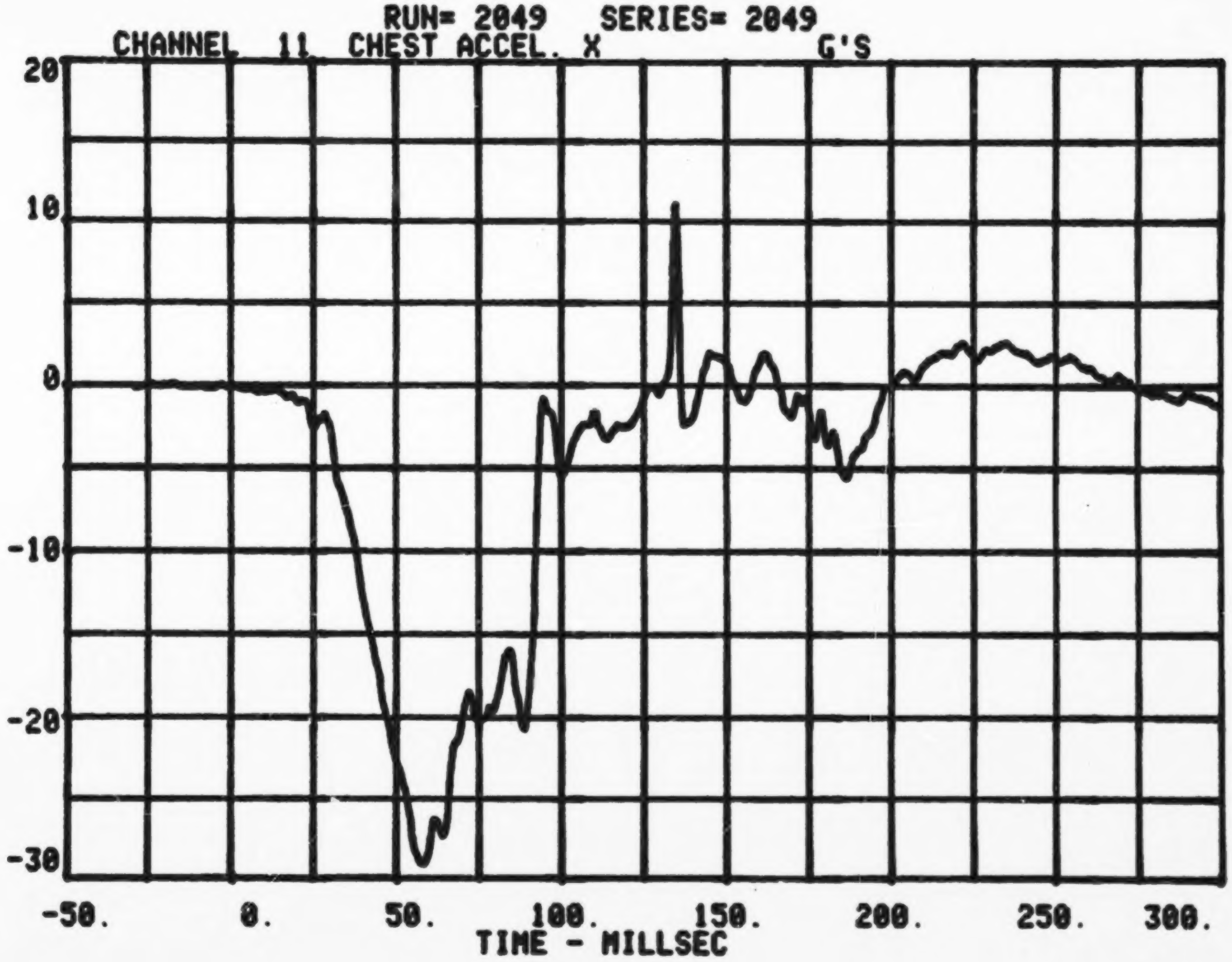

RUN= 2049 SERIES= 2049
CHANNEL 4 HEAD ACCEL. Z(1) G'S
60
45
30
15
0
-15
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



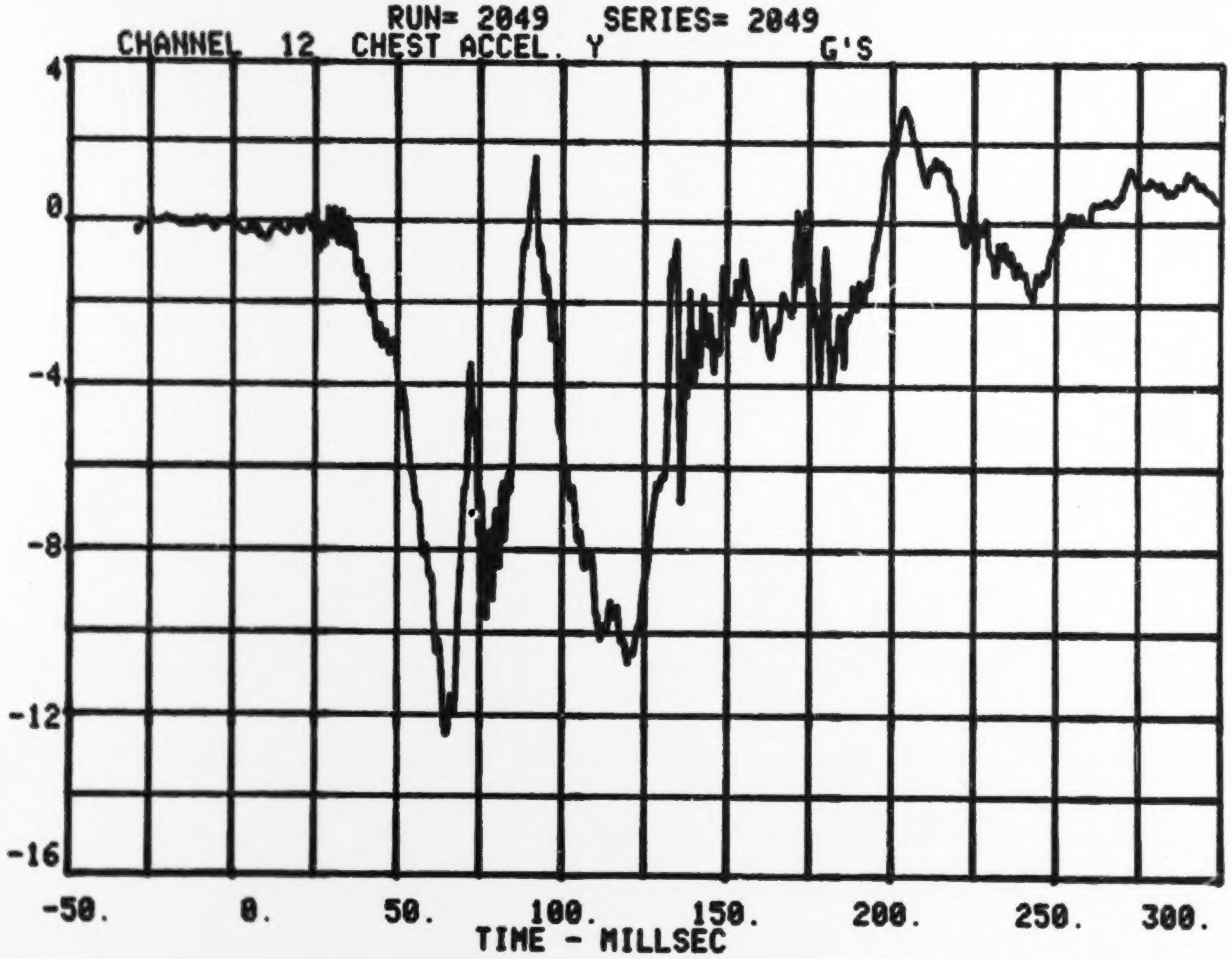
BEST DOCUMENT AVAILABLE



BEST DOCUMENT AVAILABLE

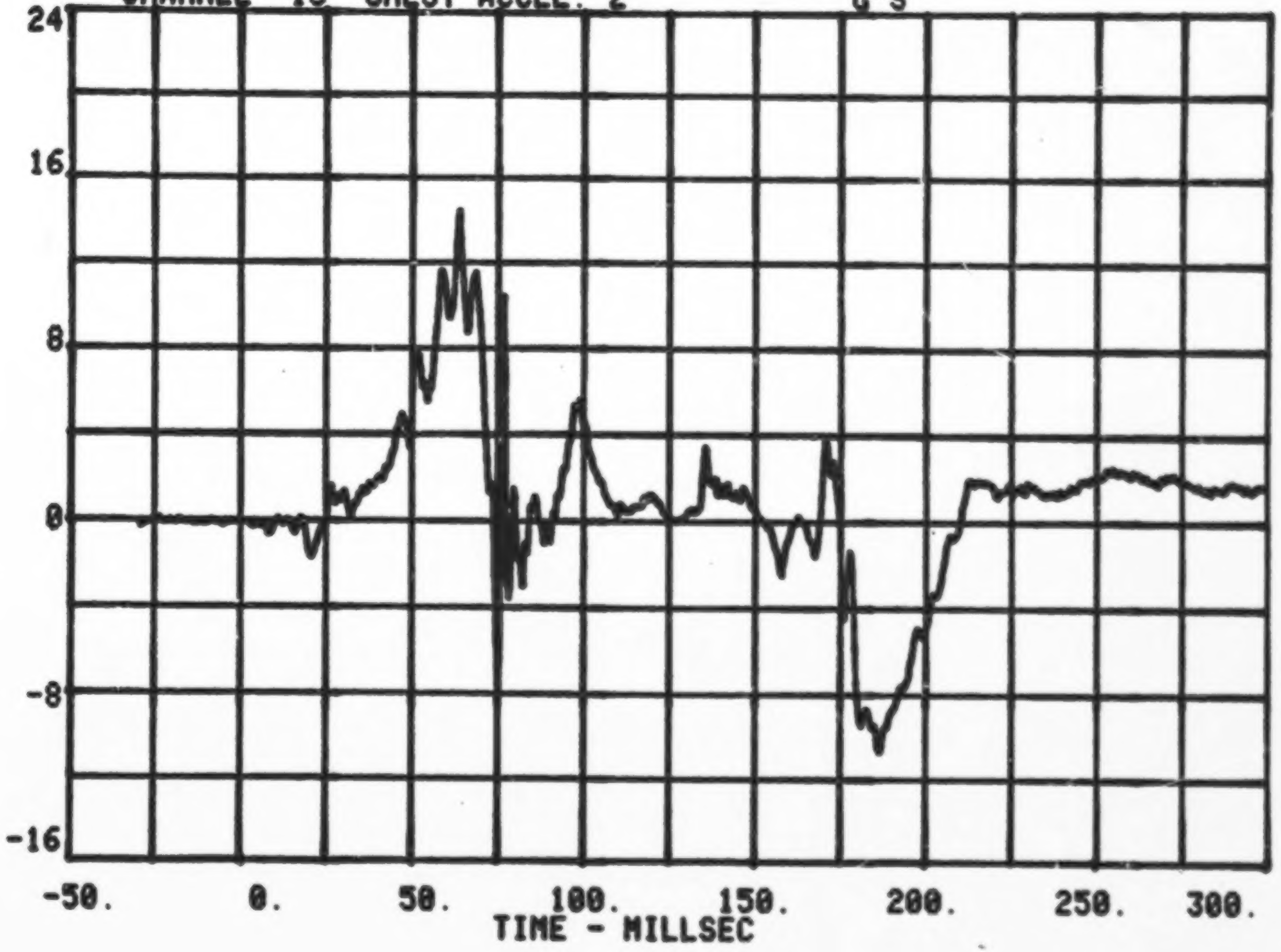


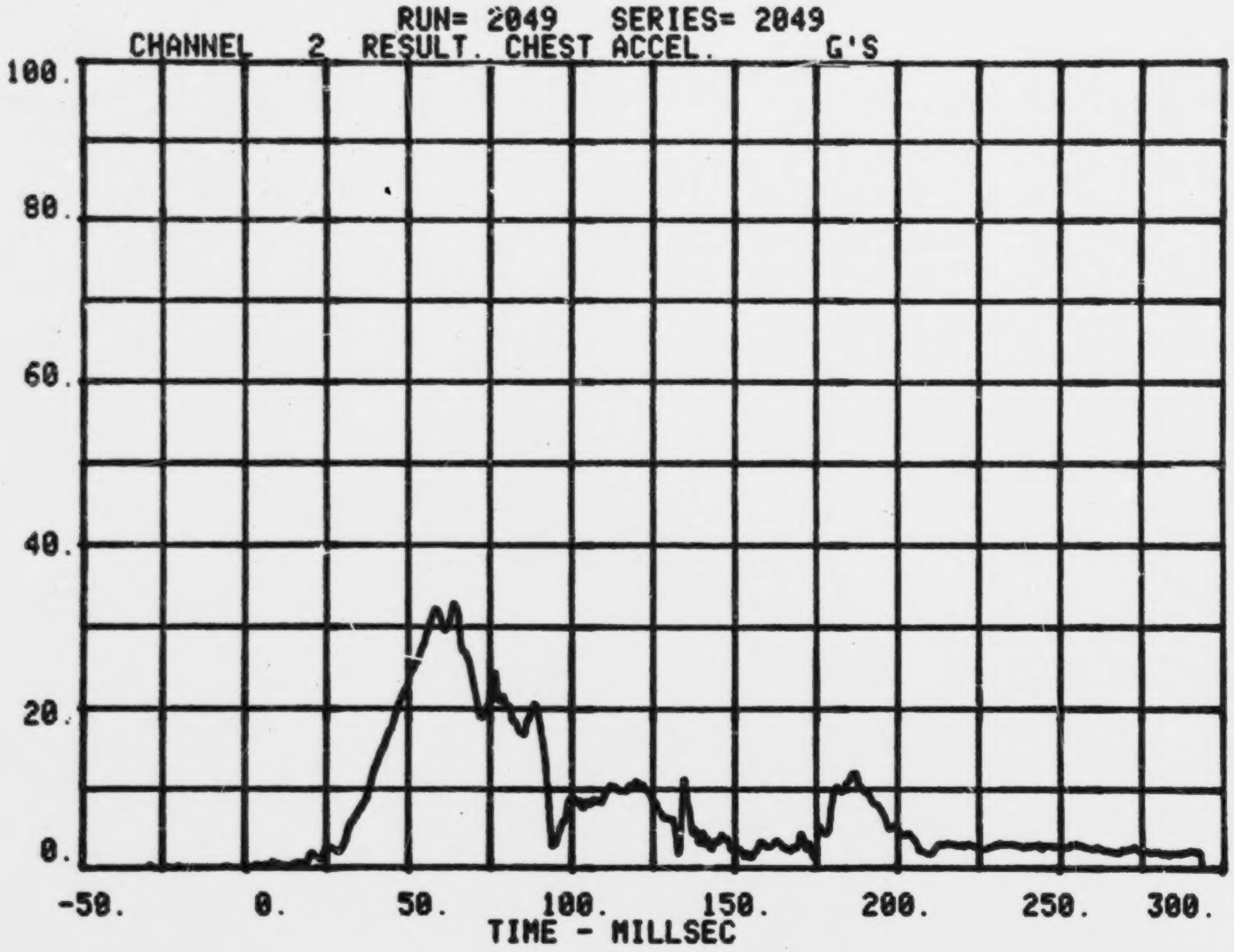
BEST DOCUMENT AVAILABLE

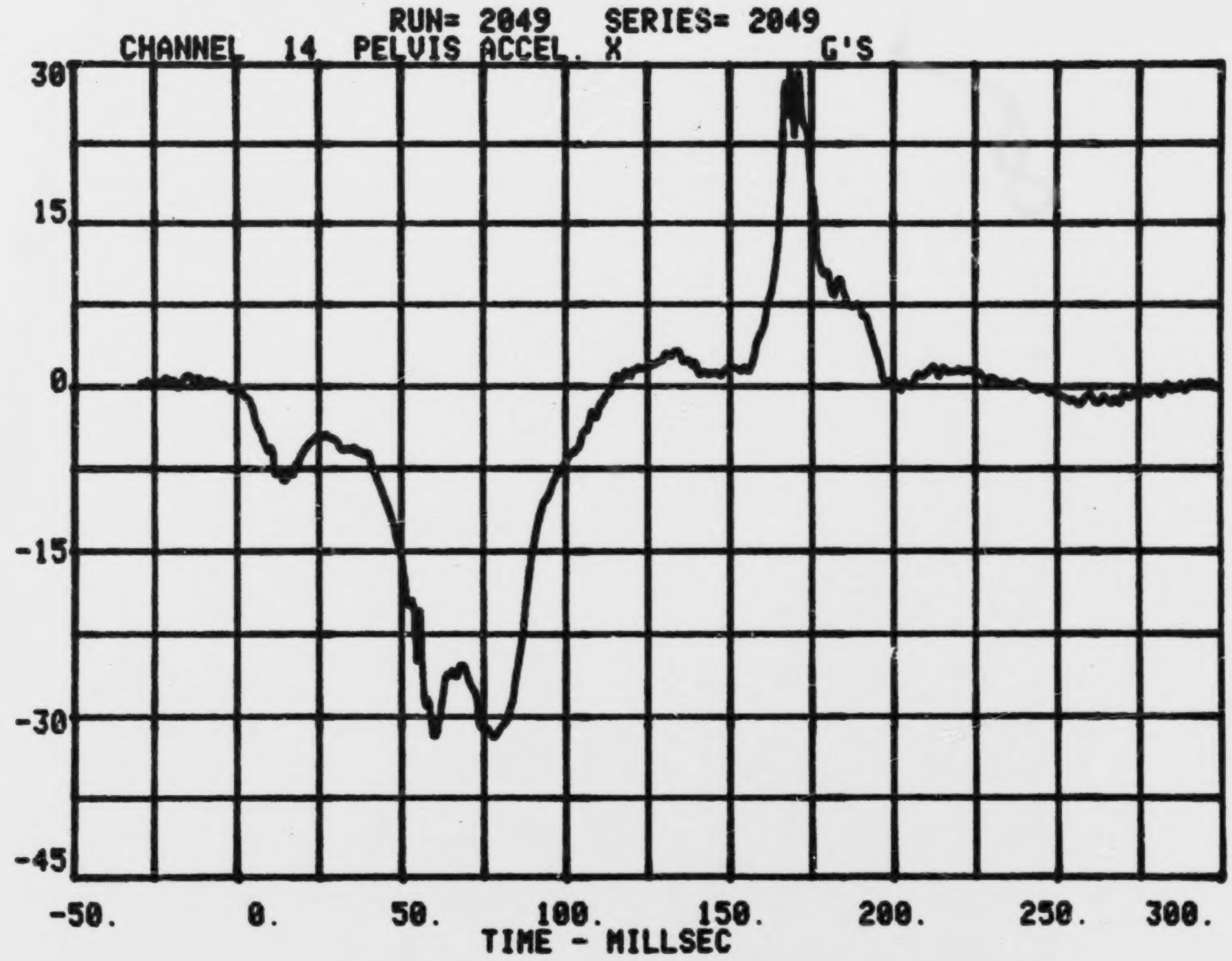


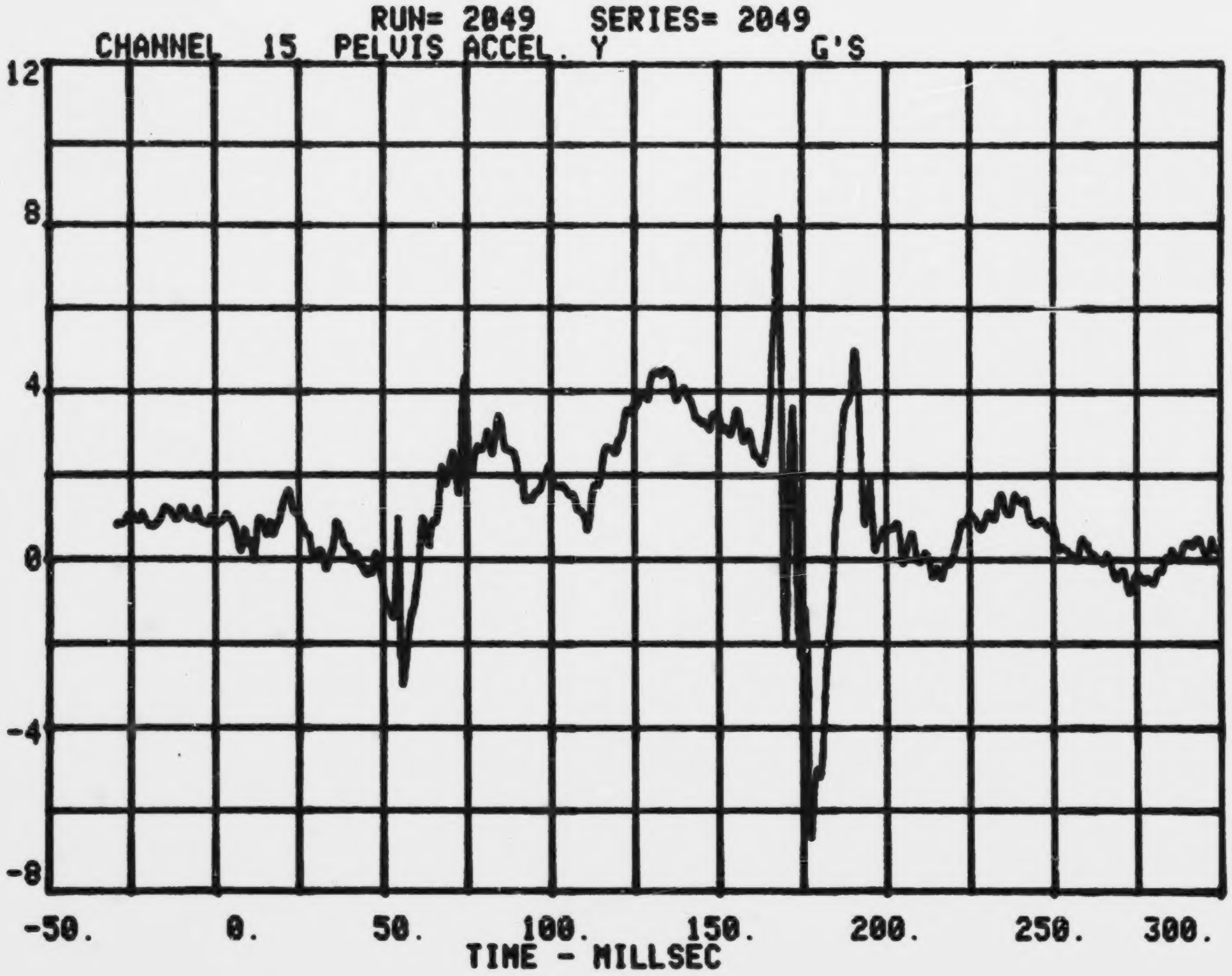
BEST DOCUMENT AVAILABLE

RUN= 2049 SERIES= 2049
CHANNEL 13 CHEST ACCEL. Z G'S




RUN= 2049 SERIES= 2049
CHANNEL 2 RESULT. CHEST ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

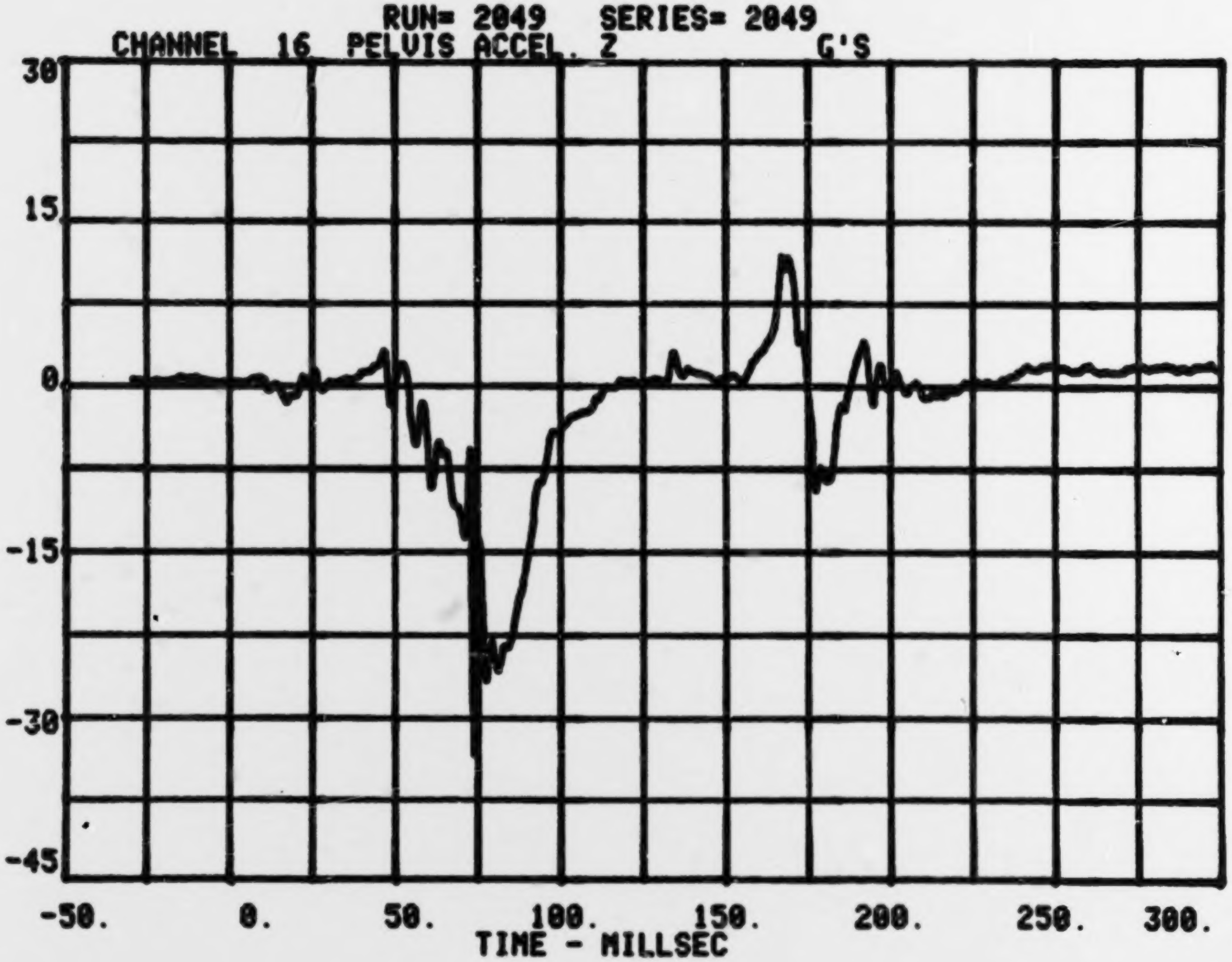

RUN= 2049 SERIES= 2049
CHANNEL 14 PELVIS ACCEL. X G'S
30
15
0
-15
-30
-45
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



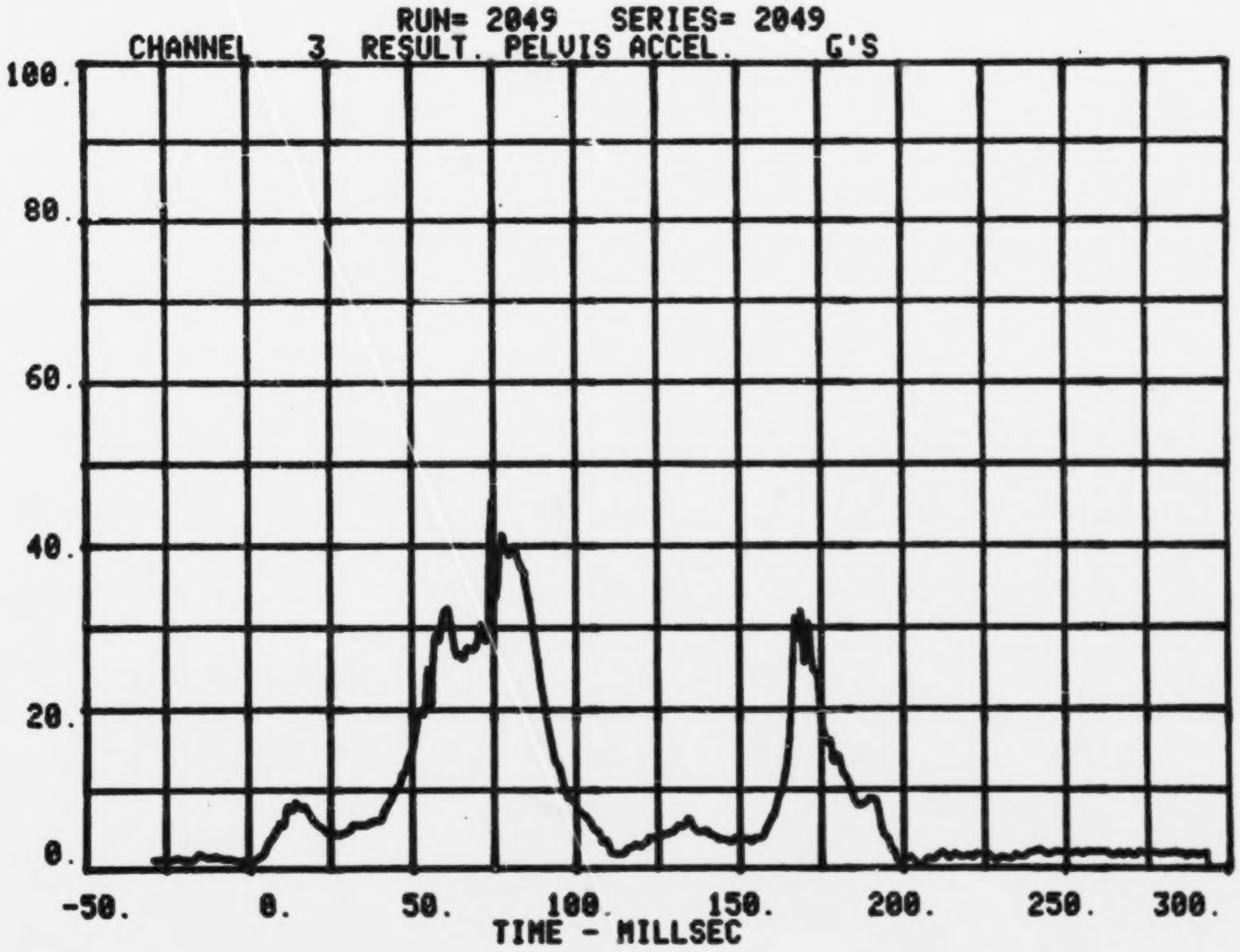
RUN= 2049 SERIES= 2049

CHANNEL 15 PELVIS ACCEL. Y G'S

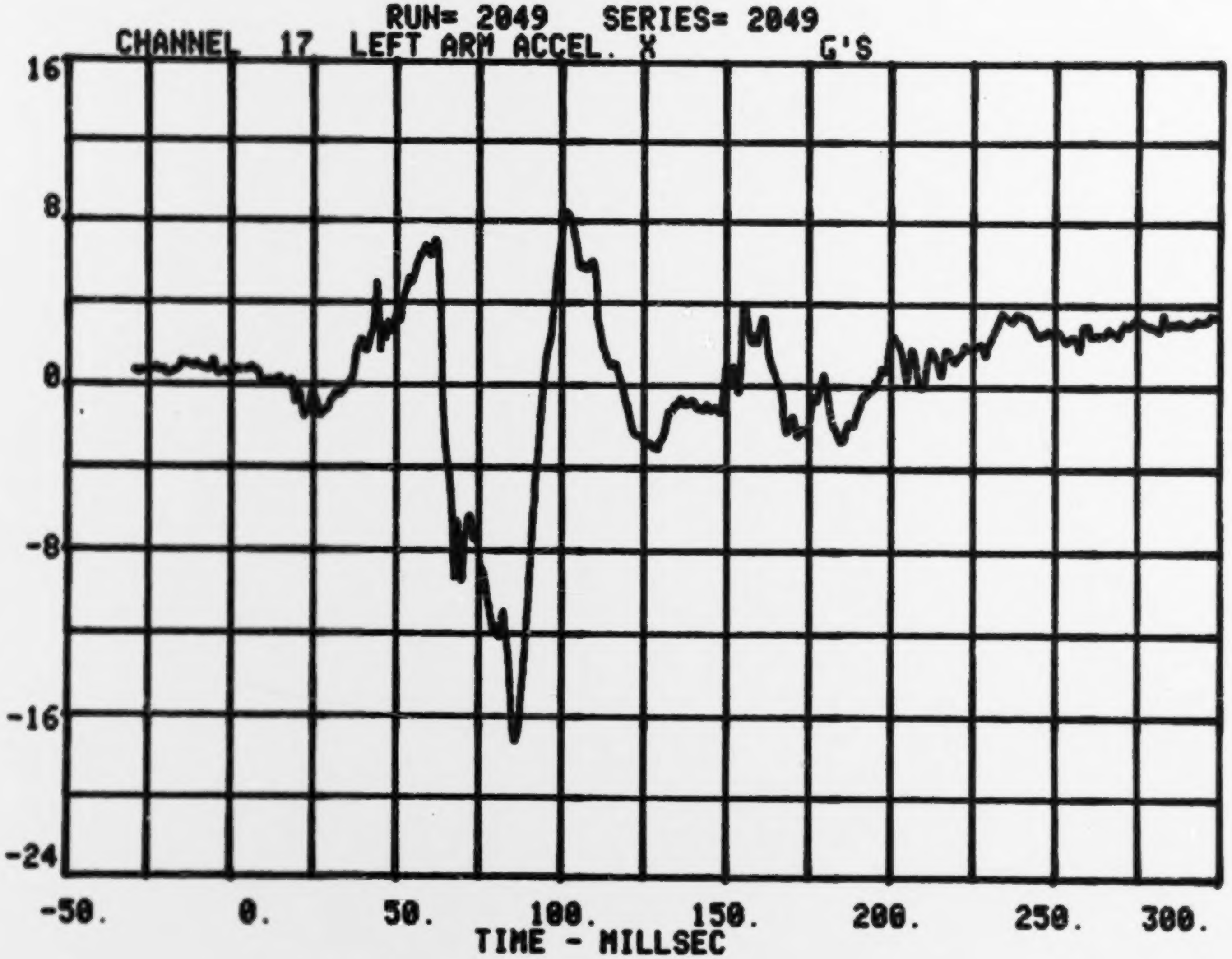
BEST DOCUMENT AVAILABLE

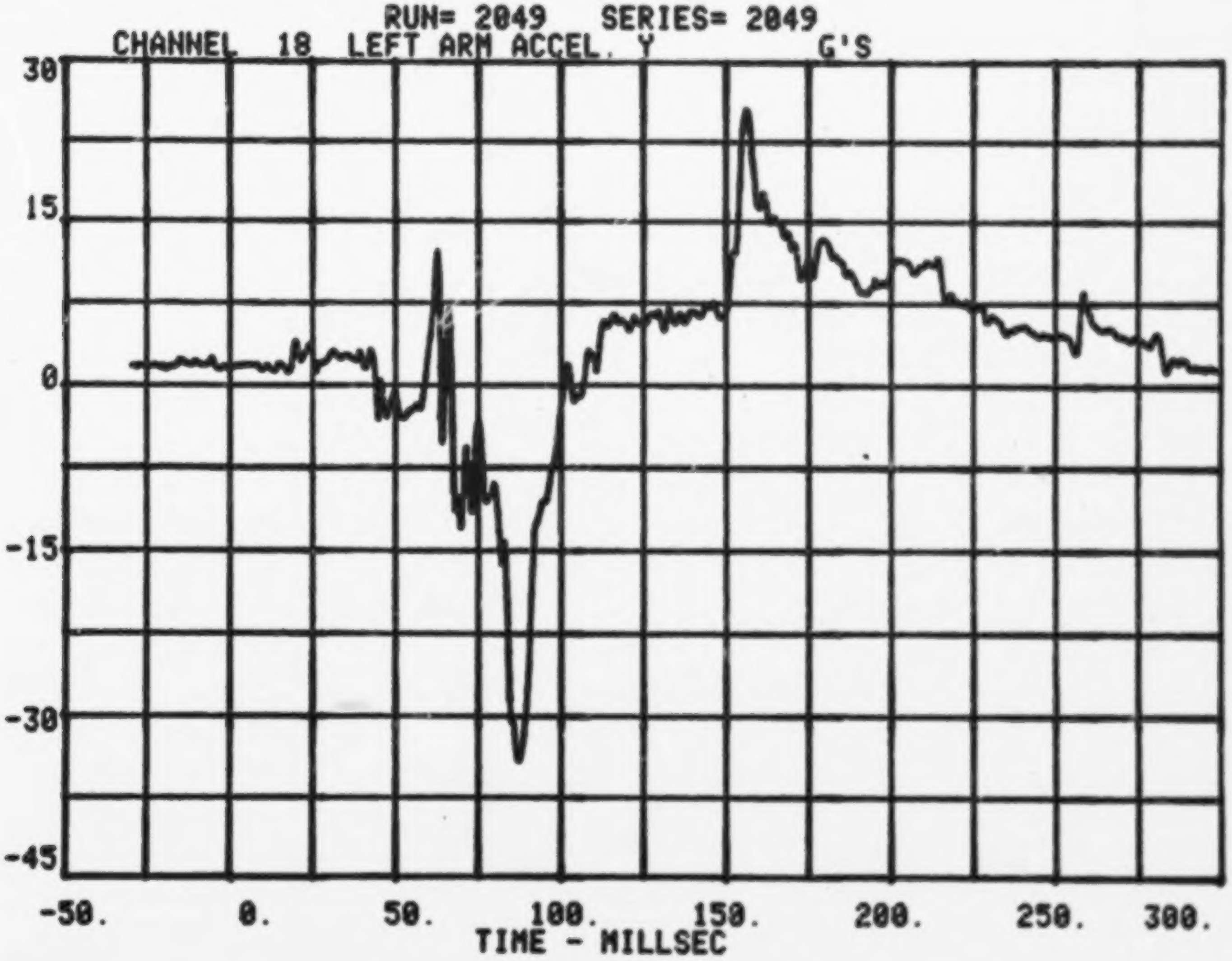


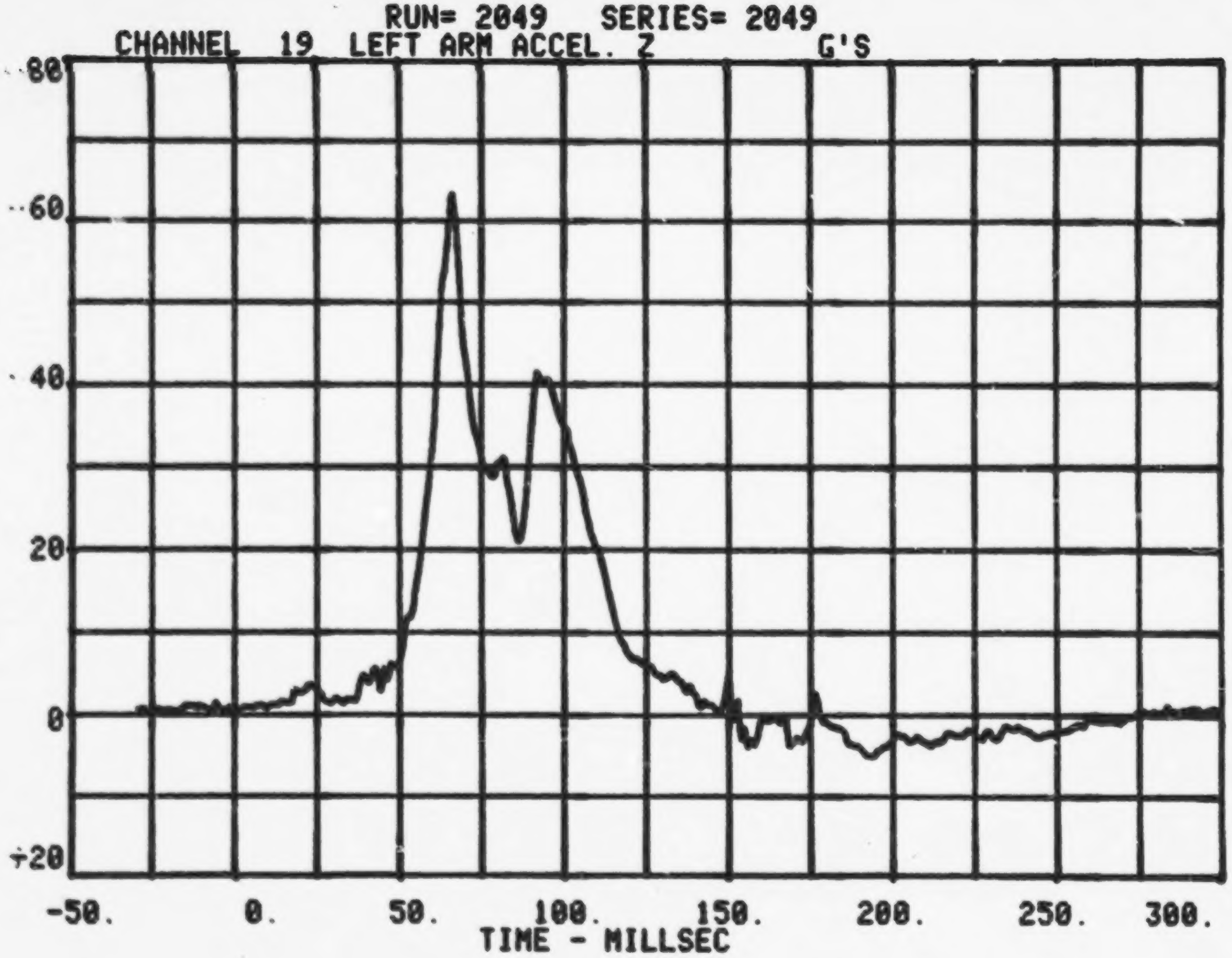
RUN= 2049 SERIES= 2049
CHANNEL 3 RESULT. PELVIS ACCEL. G'S

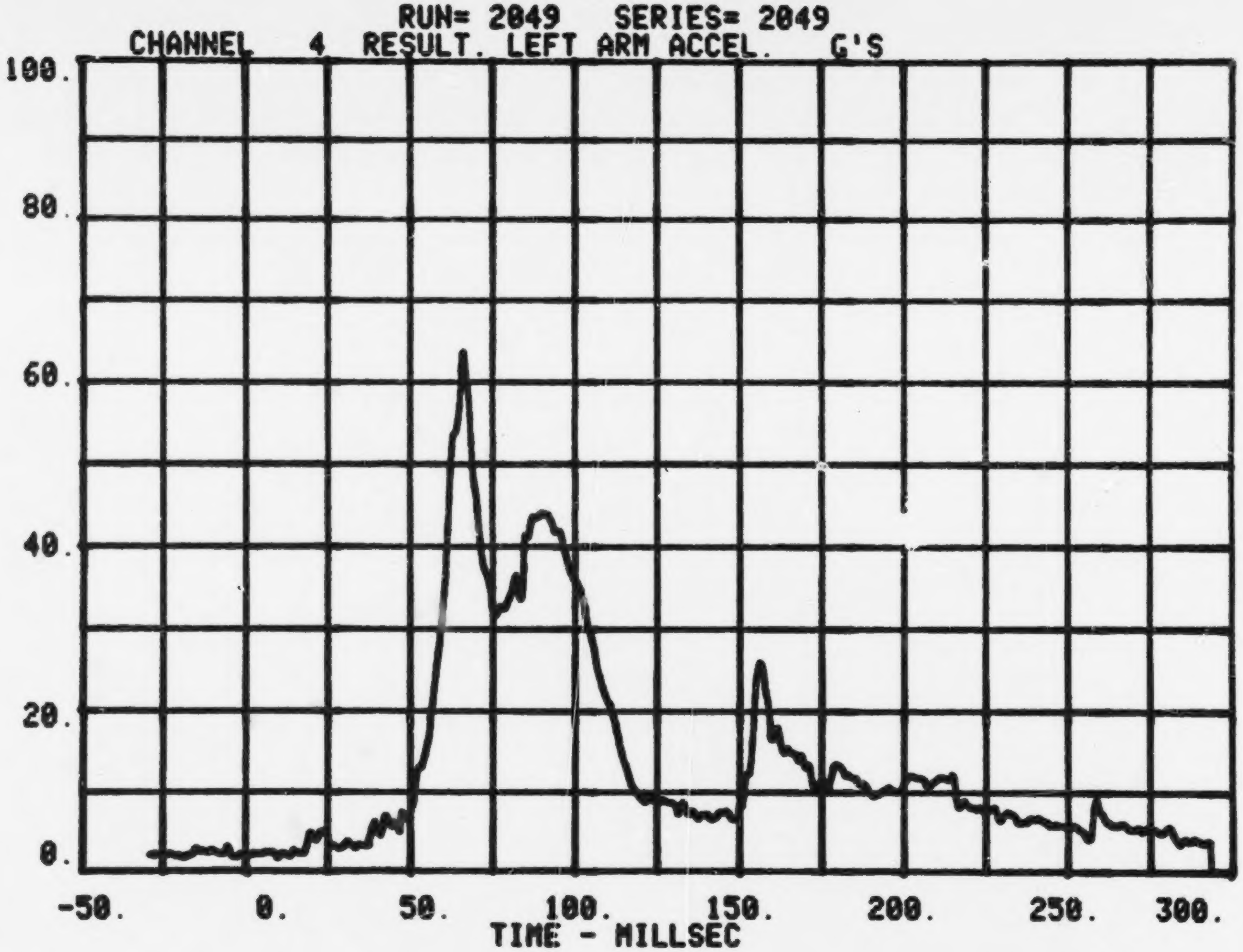


BEST DOCUMENT AVAILABLE

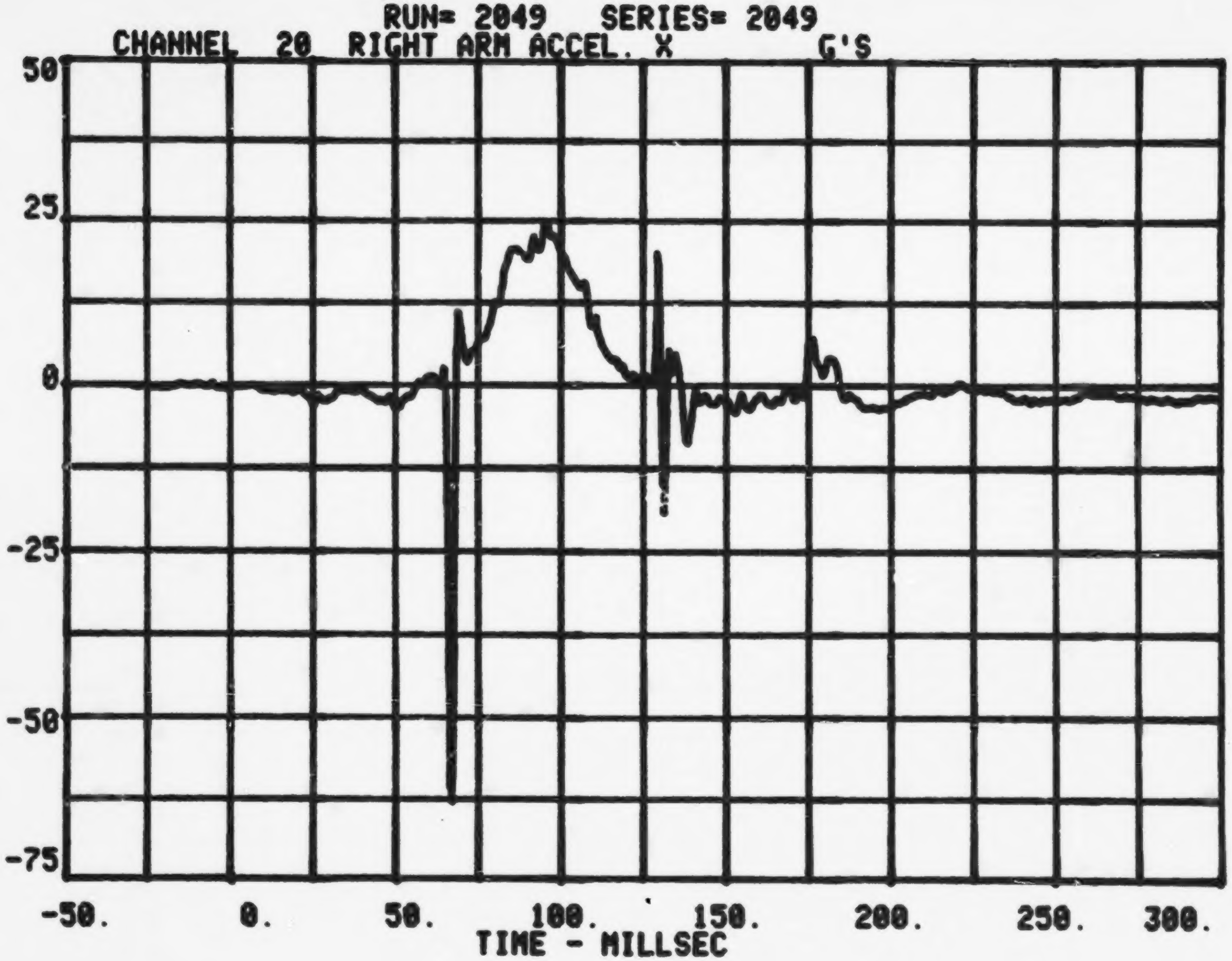

RUN= 2049 SERIES= 2049
CHANNEL 17 LEFT ARM ACCEL. X G'S
16
8
0
-8
-16
-24
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2049 SERIES= 2049
CHANNEL 18 LEFT ARM ACCEL. Y G'S
30
15
0
-15
-30
-45
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2049 SERIES= 2049
CHANNEL 19 LEFT ARM ACCEL. Z G'S
80
60
40
20
0
-20
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

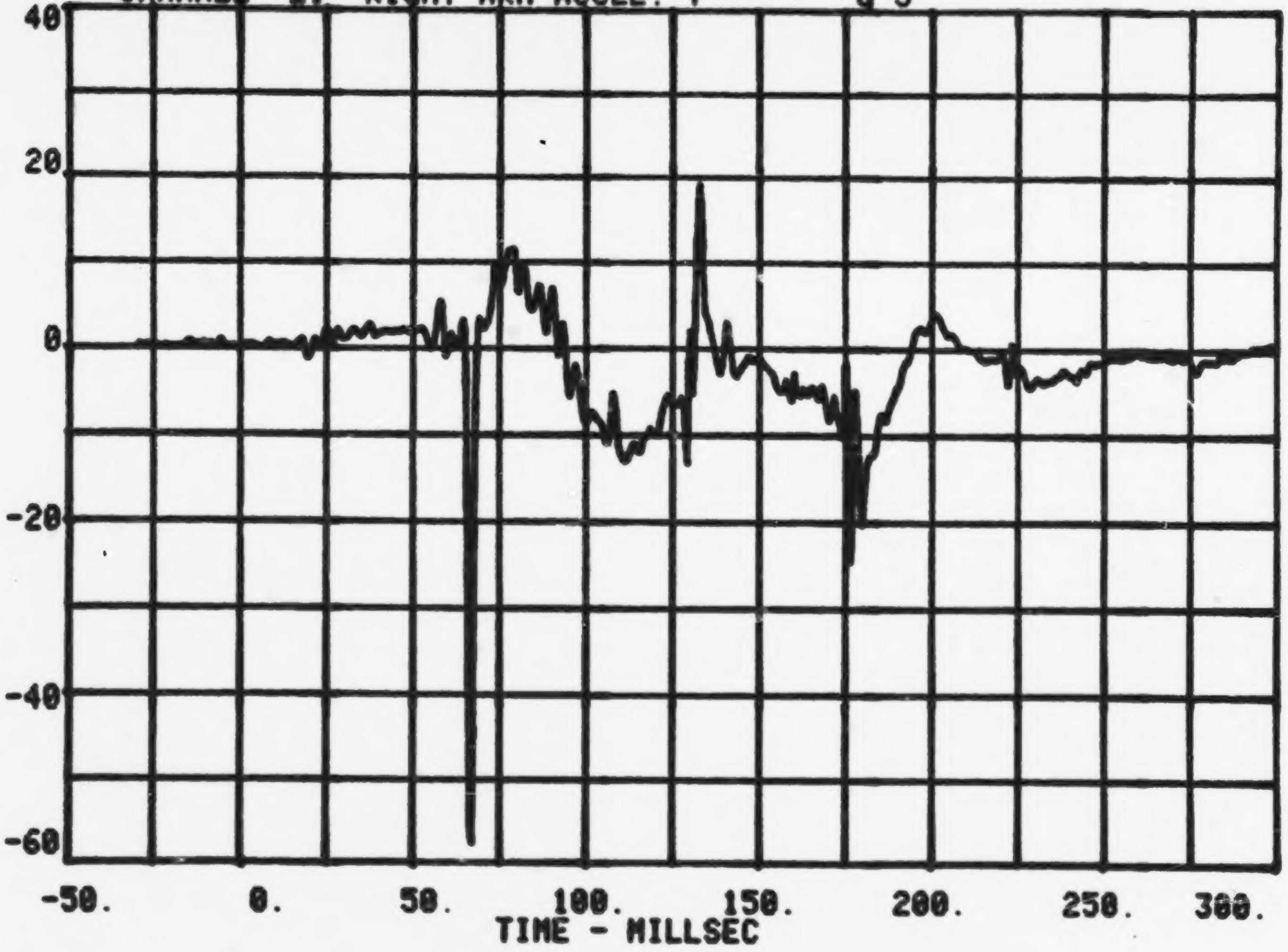


BEST DOCUMENT AVAILABLE


RUN= 2049 SERIES= 2049
CHANNEL 20 RIGHT ARM ACCEL. X G'S
50
25
0
-25
-50
-75
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

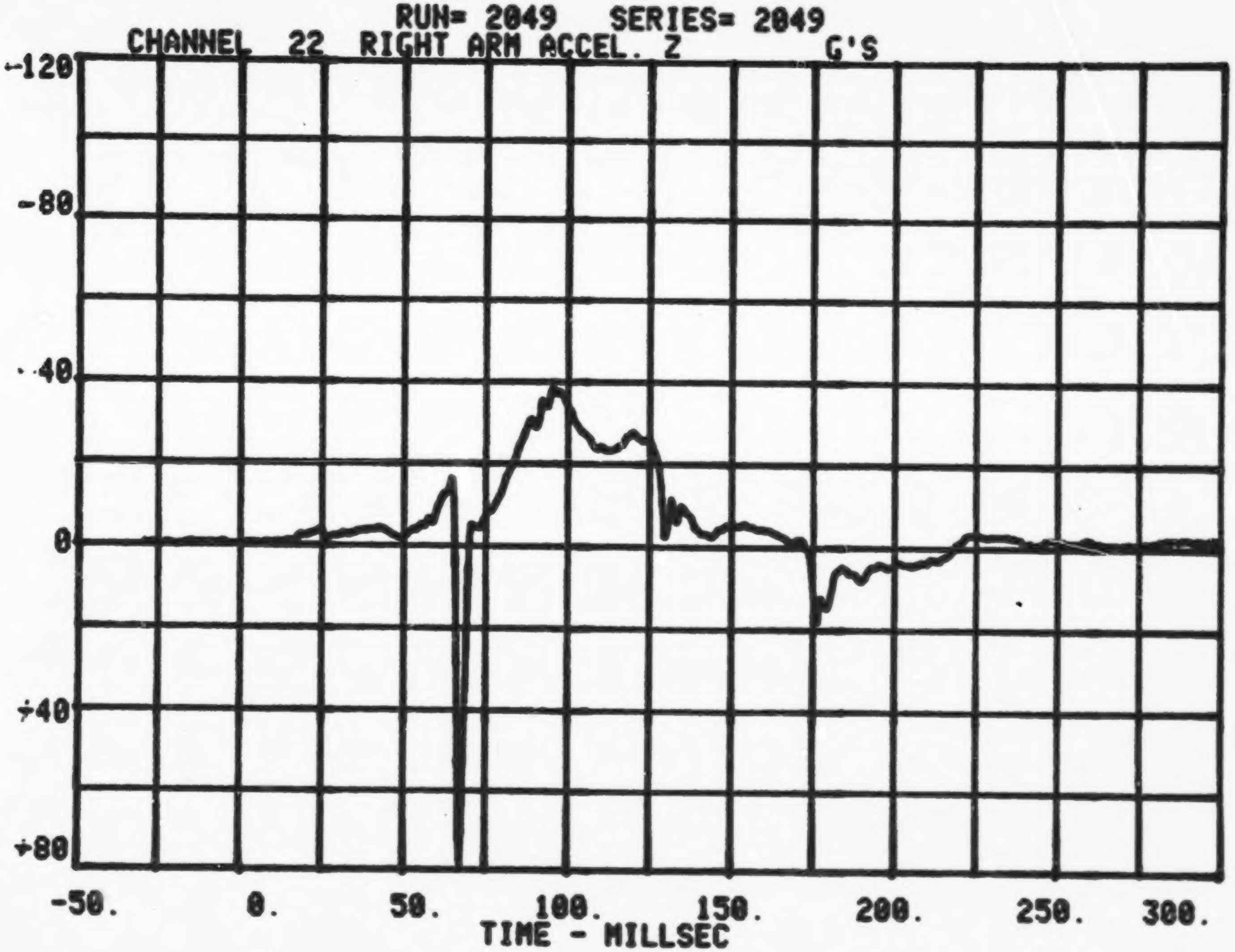
285

RUN= 2049 SERIES= 2049

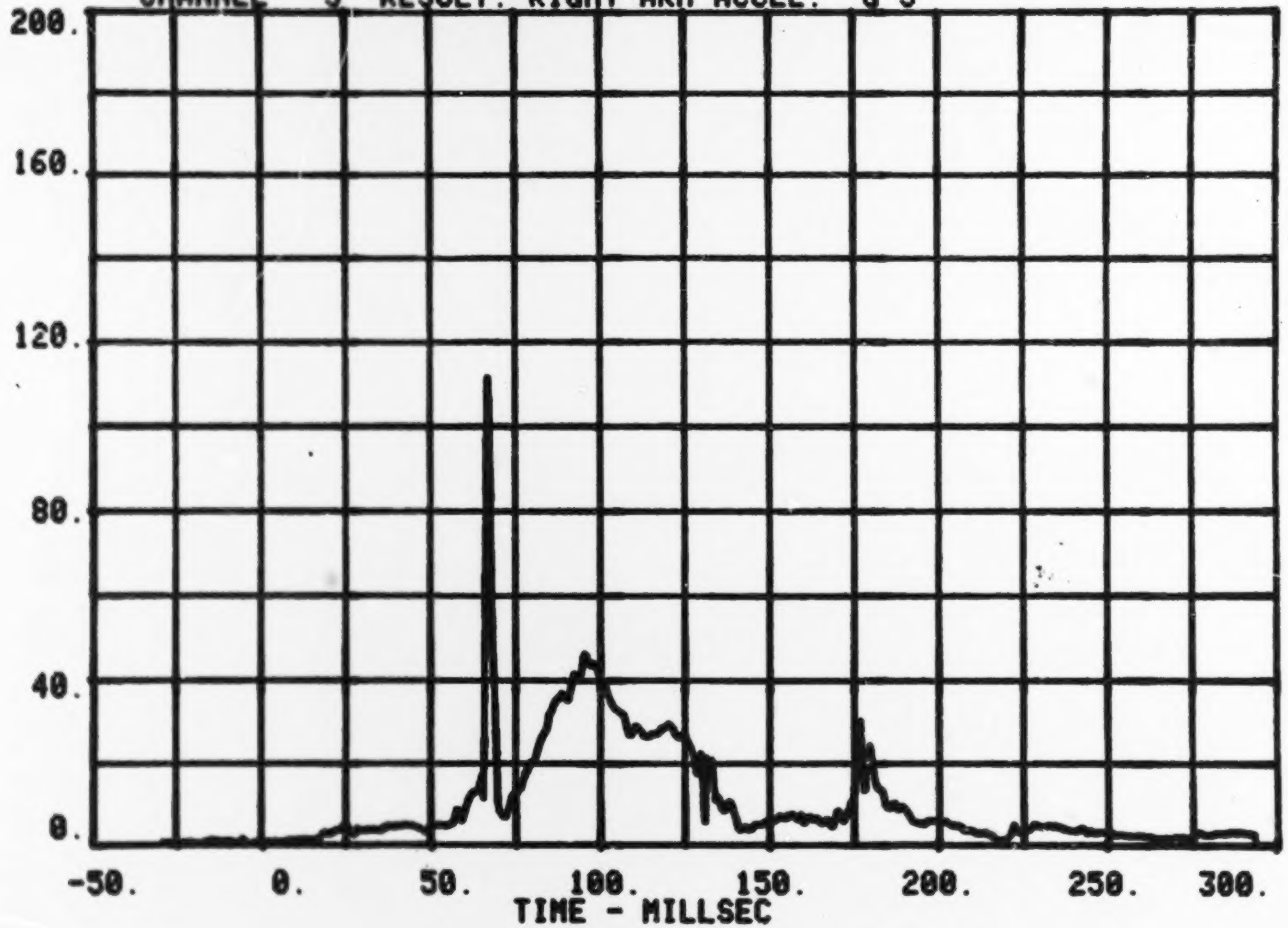


BEST DOCUMENT AVAILABLE

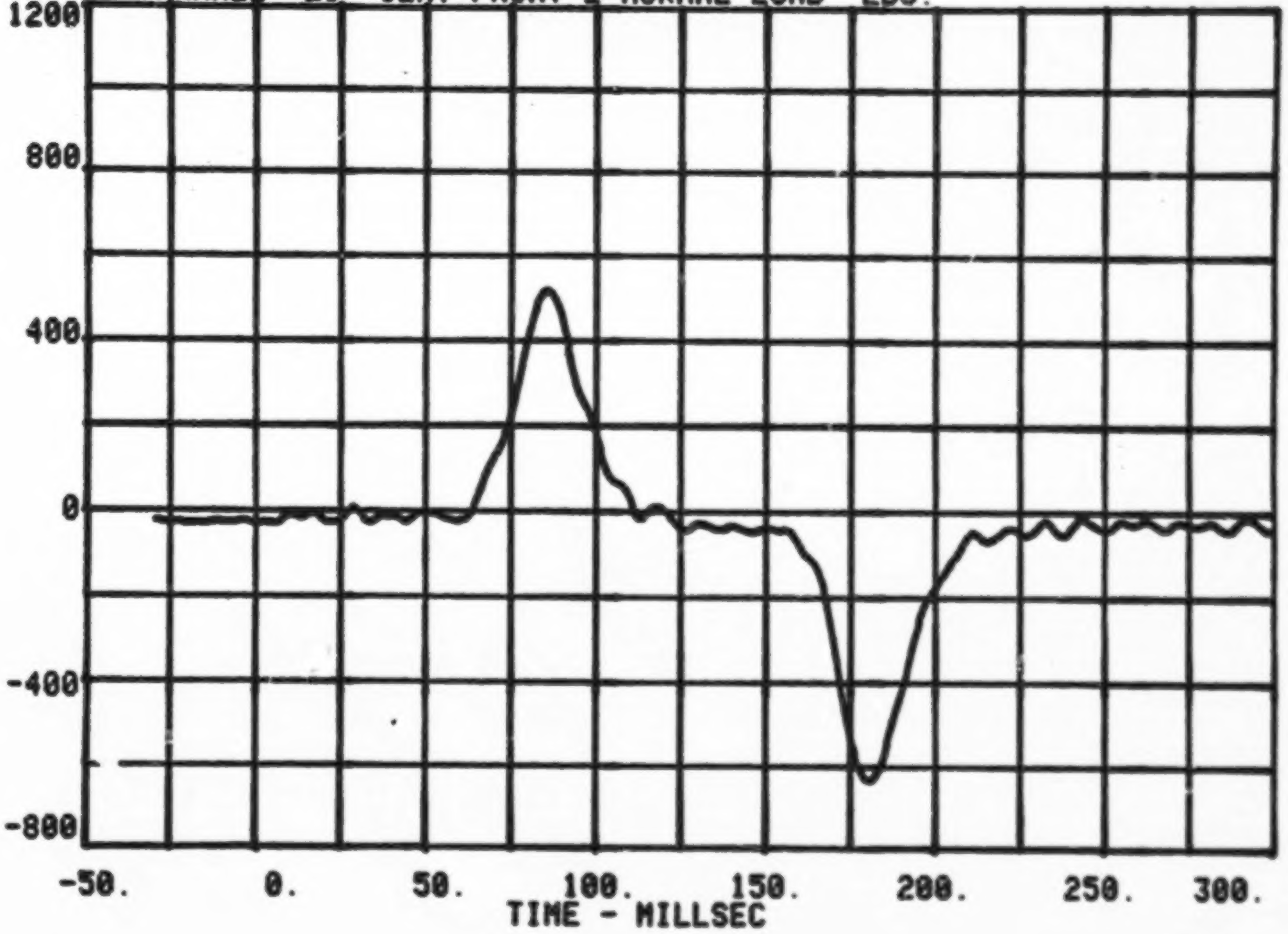
BEST DOCUMENT AVAILABLE

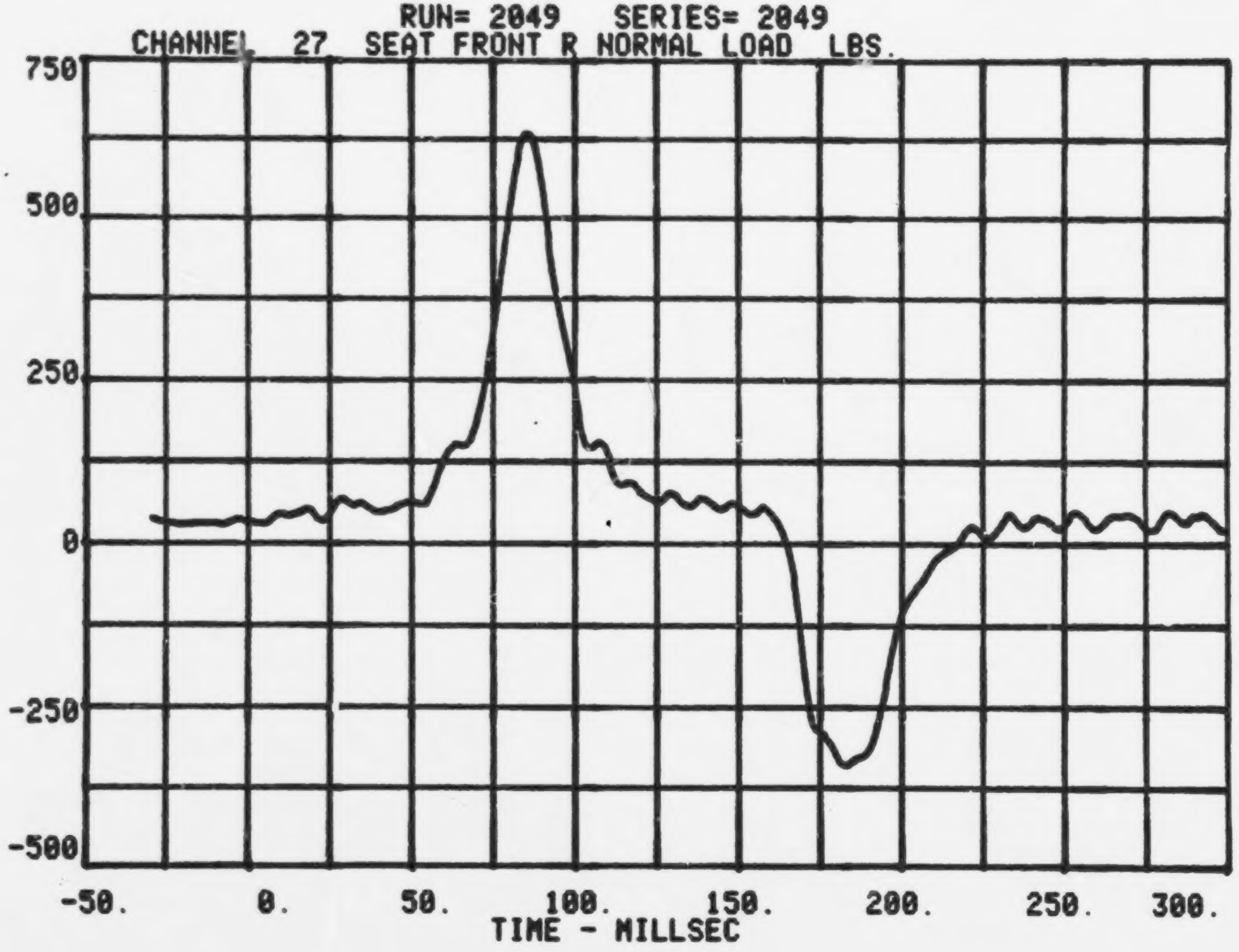


RUN= 2049 SERIES= 2049
CHANNEL 5 RESULT. RIGHT ARM ACCEL. G'S



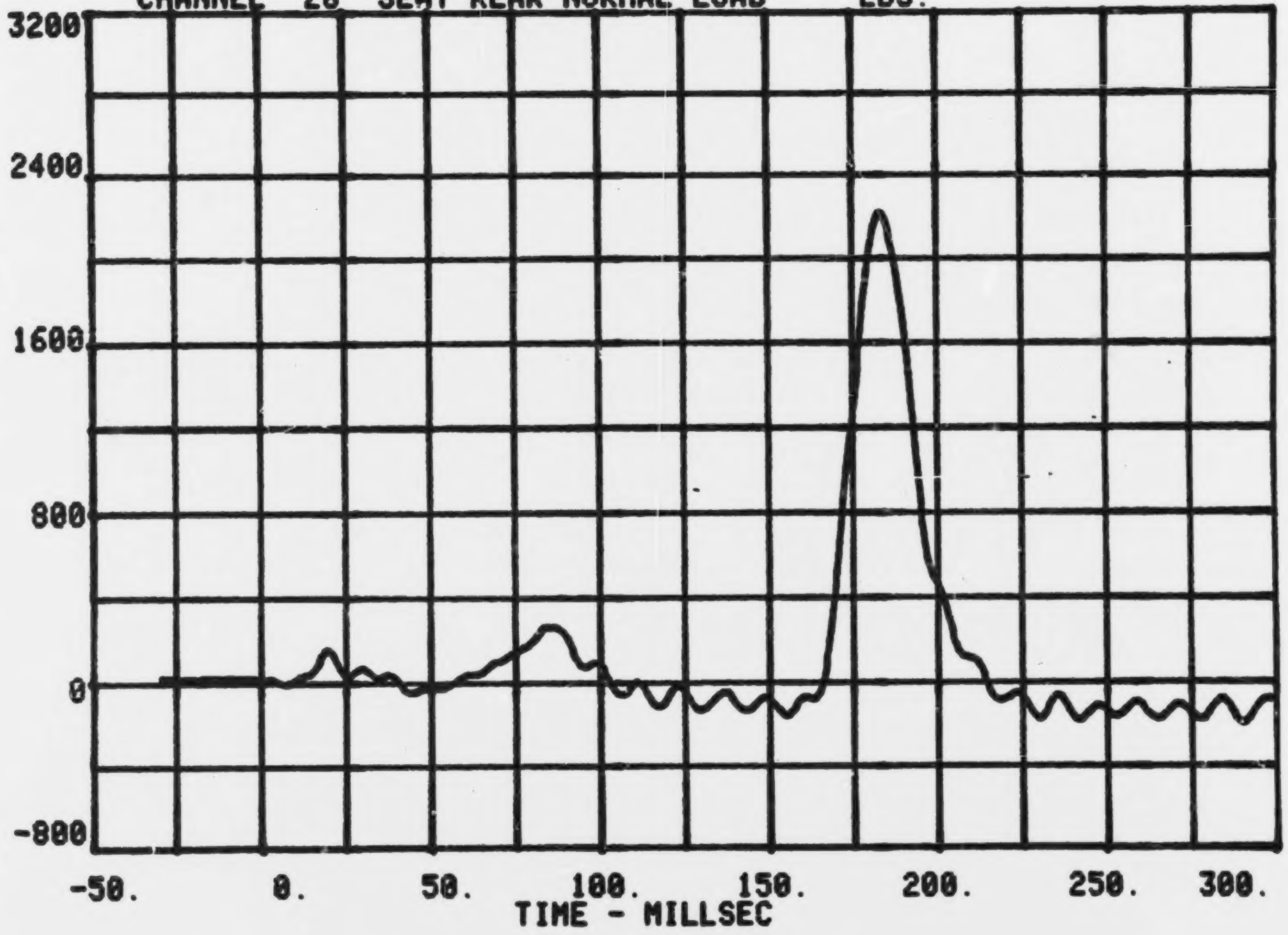
RUN= 2049   SERIES= 2049
CHANNEL 26 SEAT FRONT L NORMAL LOAD LBS.



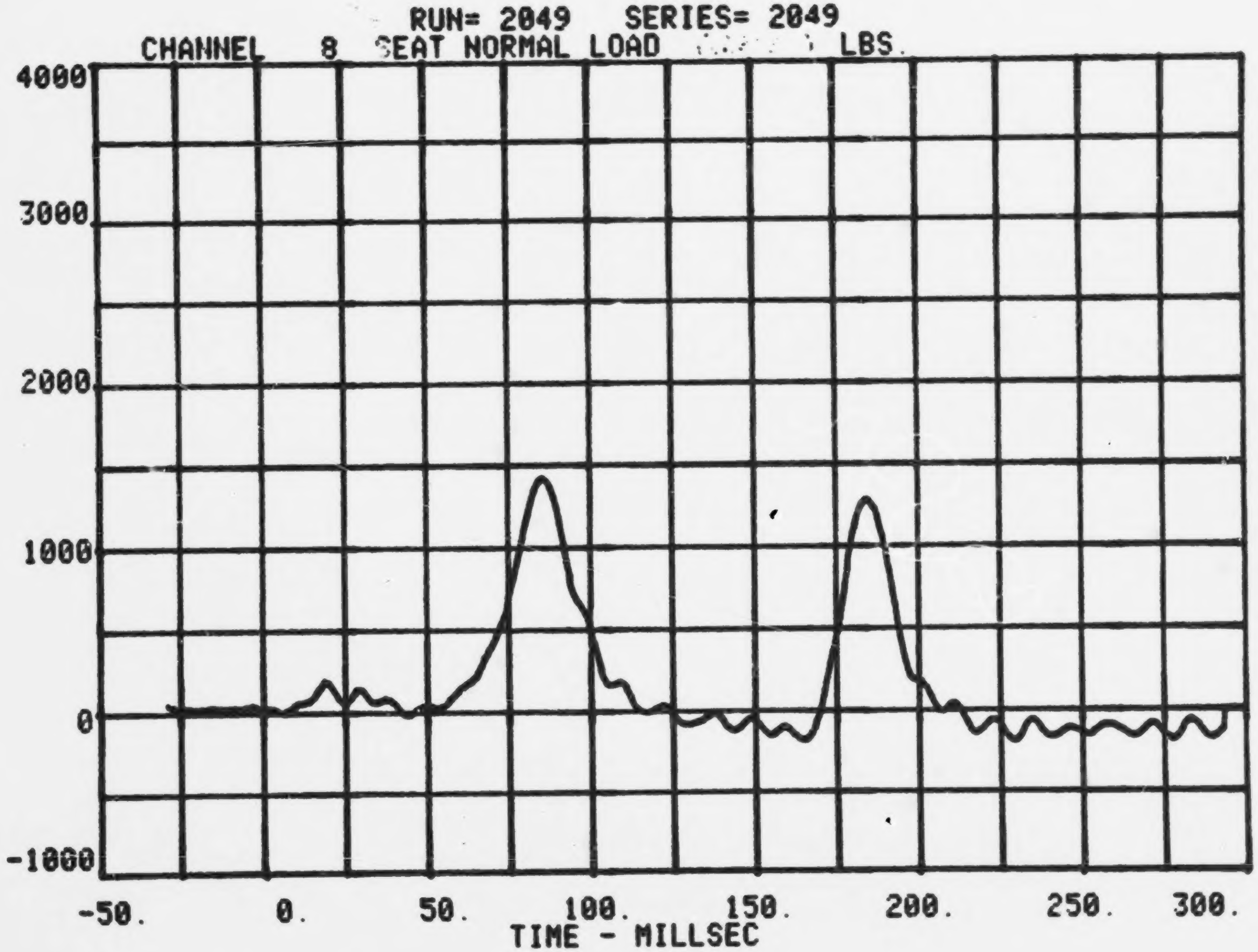


BEST DOCUMENT AVAILABLE

RUN= 2049 SERIES= 2049
CHANNEL 28 SEAT REAR NORMAL LOAD LBS.

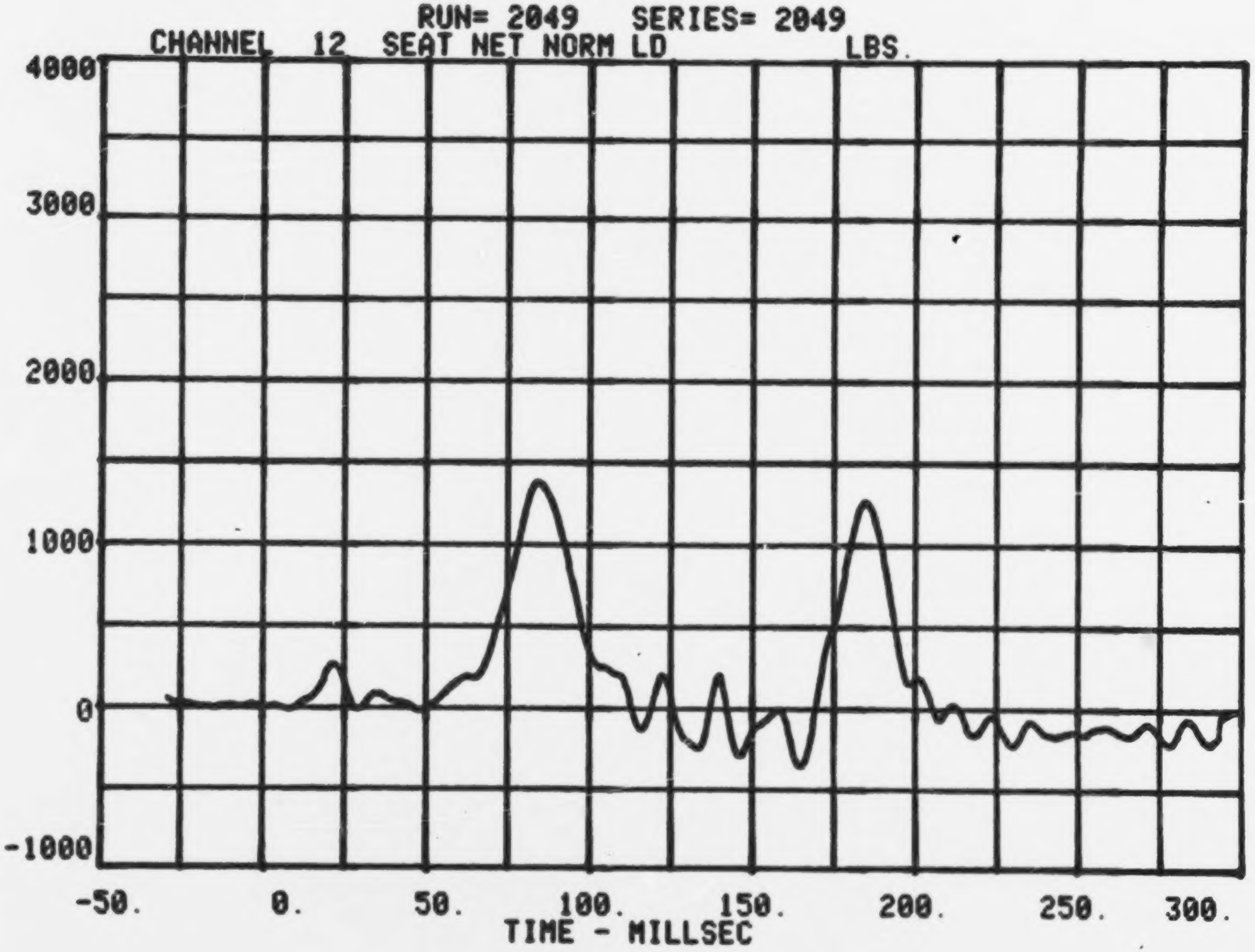


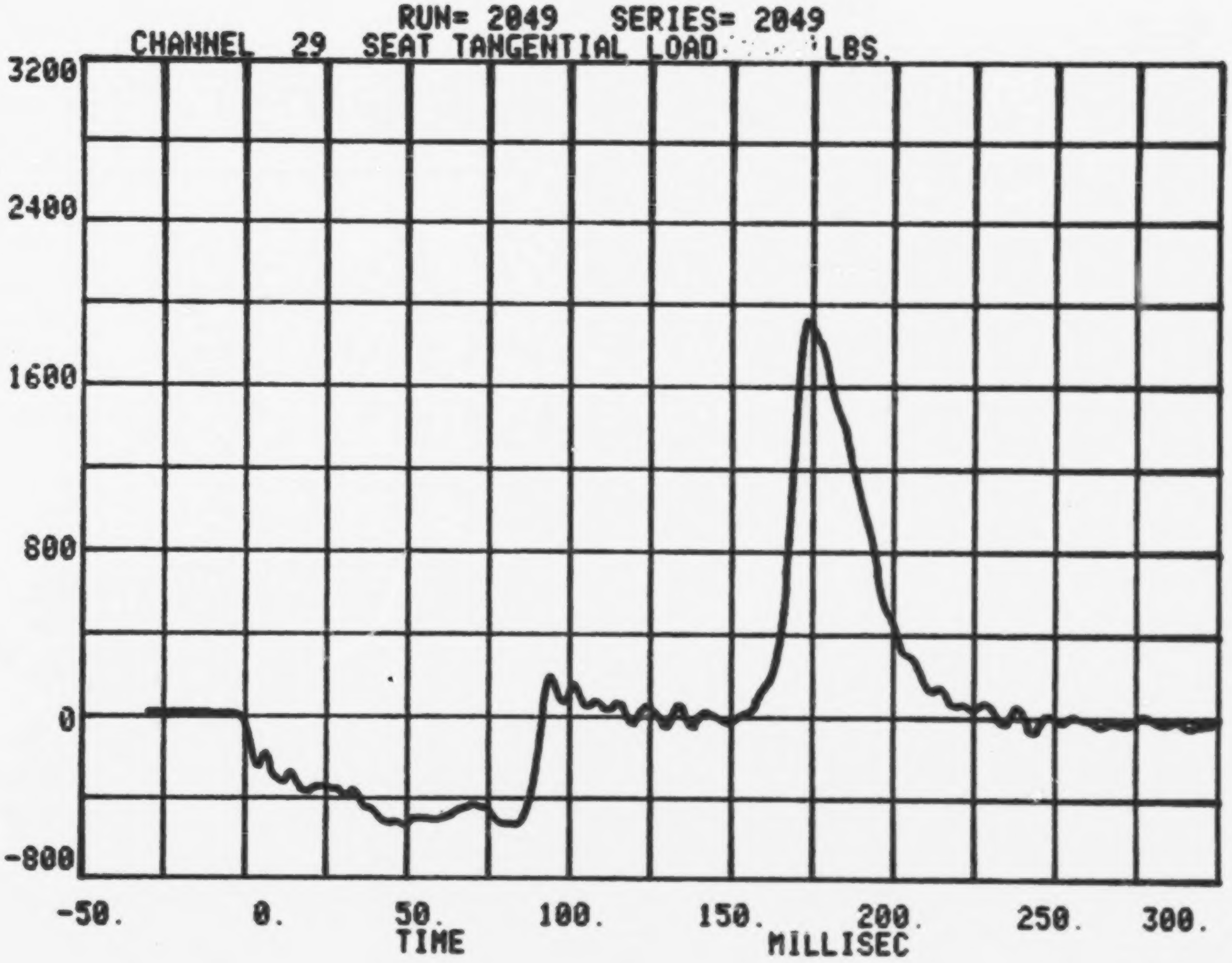
[redacted]

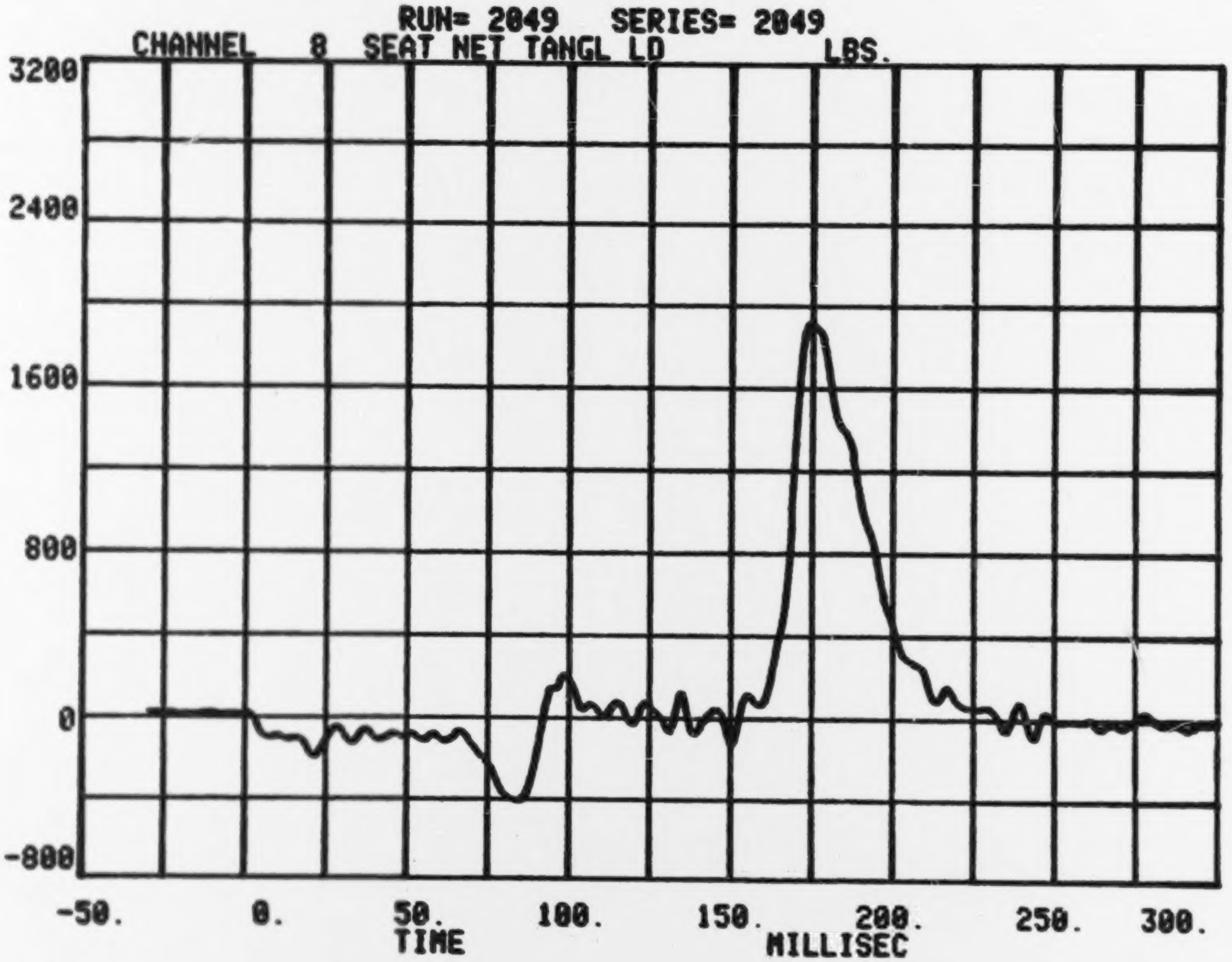


BEST DOCUMENT AVAILABLE

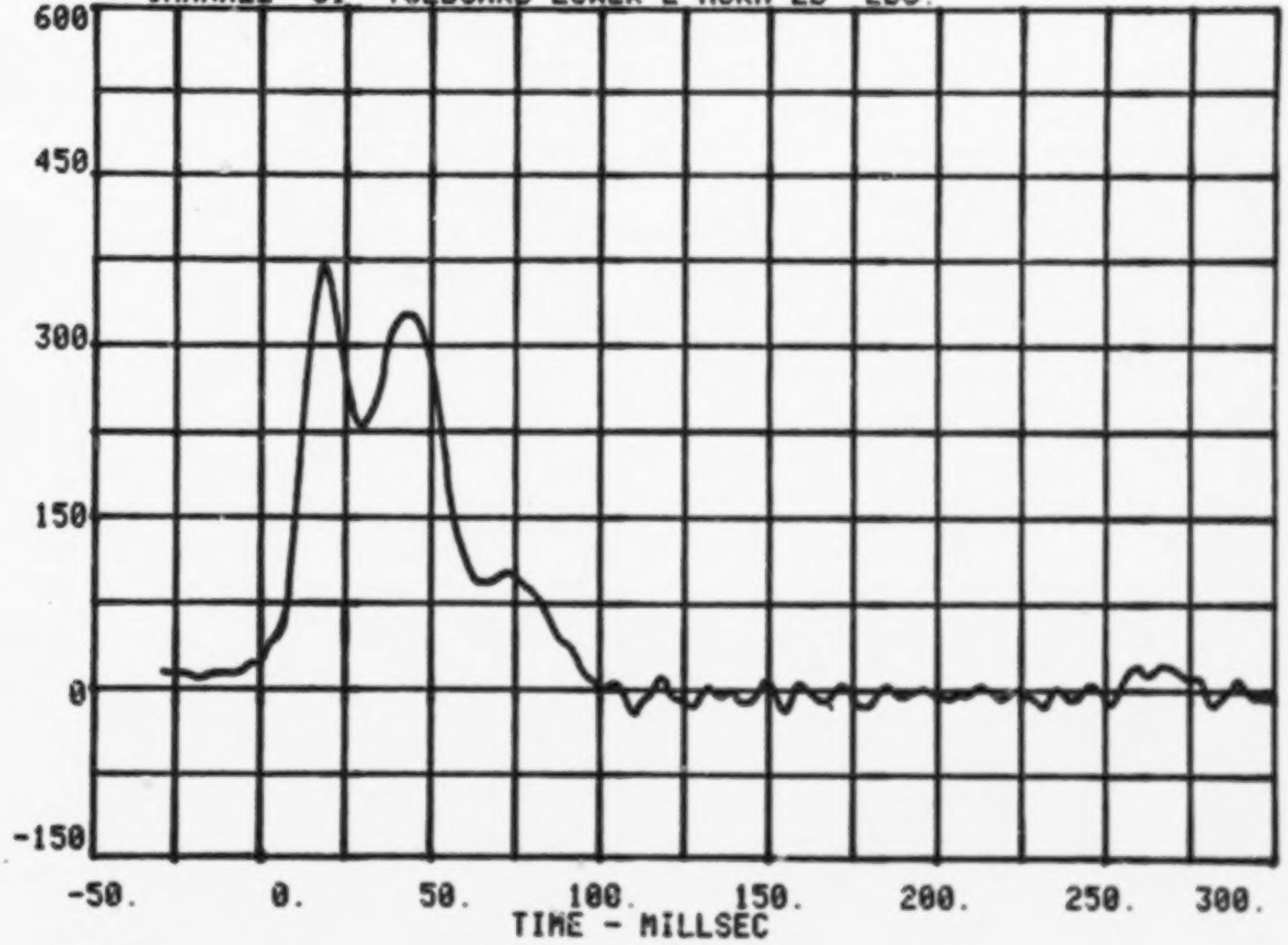
BEST DOCUMENT AVAILABLE



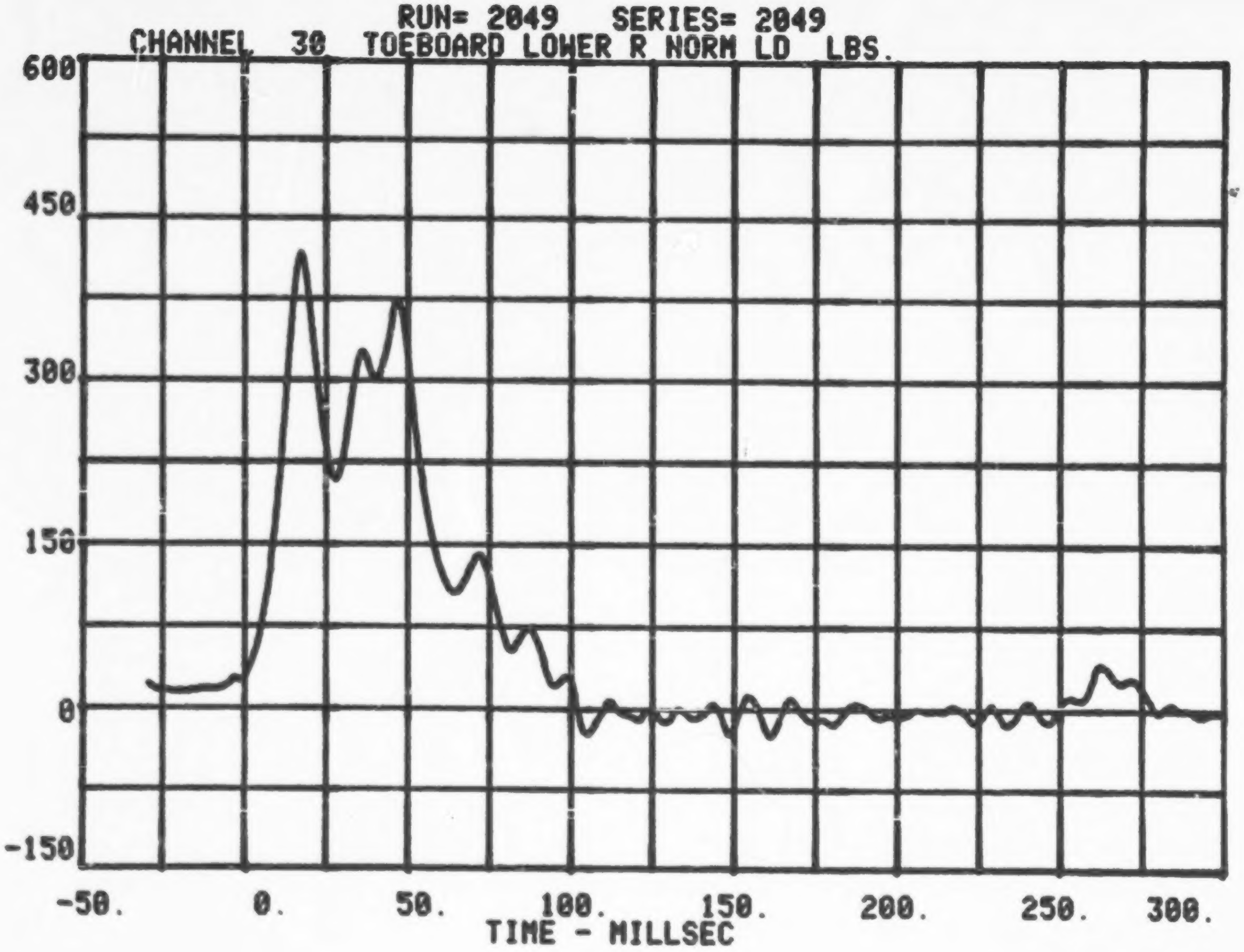

RUN= 2049 SERIES= 2049
CHANNEL 29 SEAT TANGENTIAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2049 SERIES= 2049
CHANNEL 8 SEAT NET TANGL LD
LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

RUN= 2049 SERIES= 2049
CHANNEL 31 TOEBOARD LOWER L NORM LD LBS.

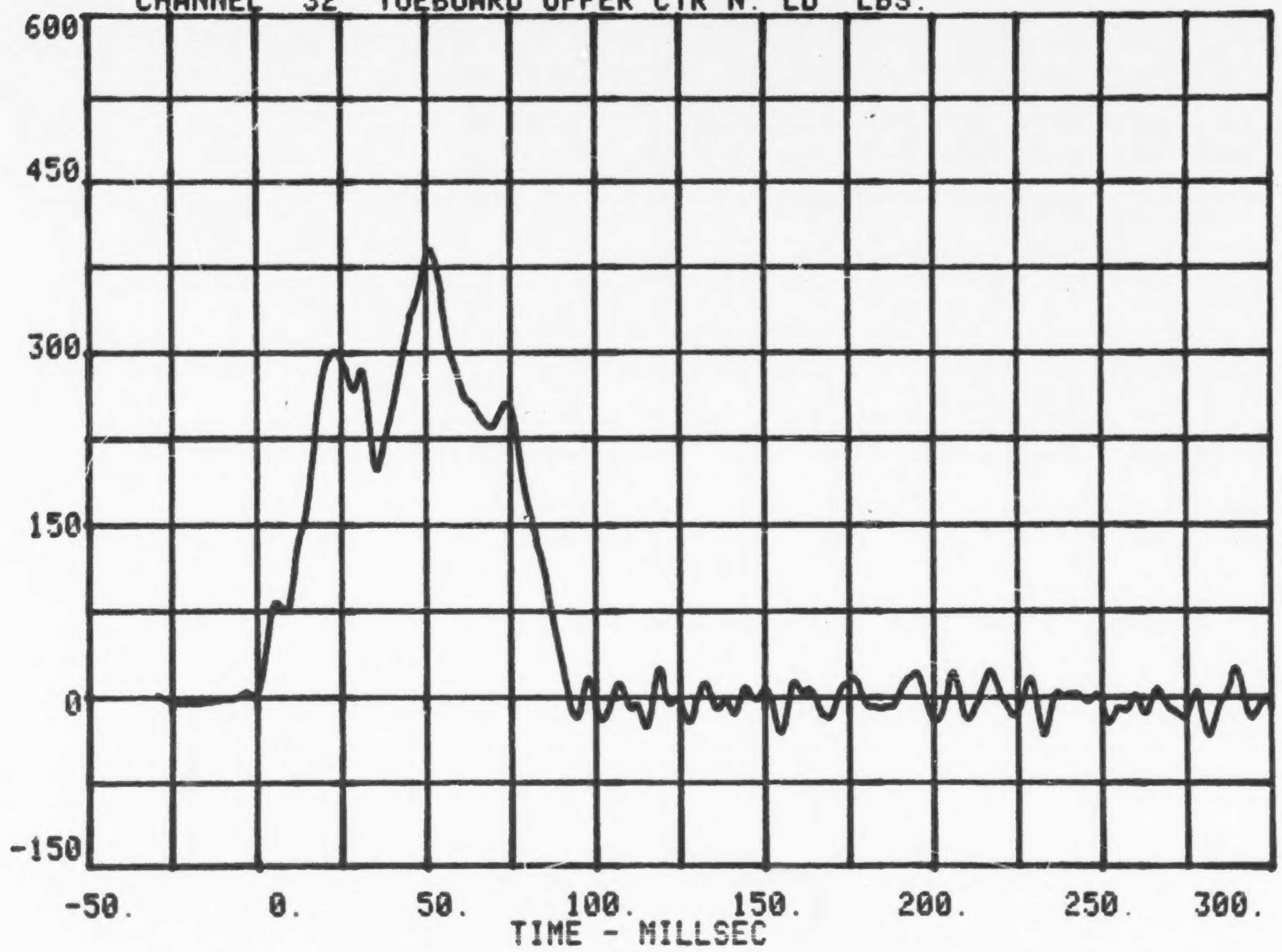


BEST DOCUMENT AVAILABLE

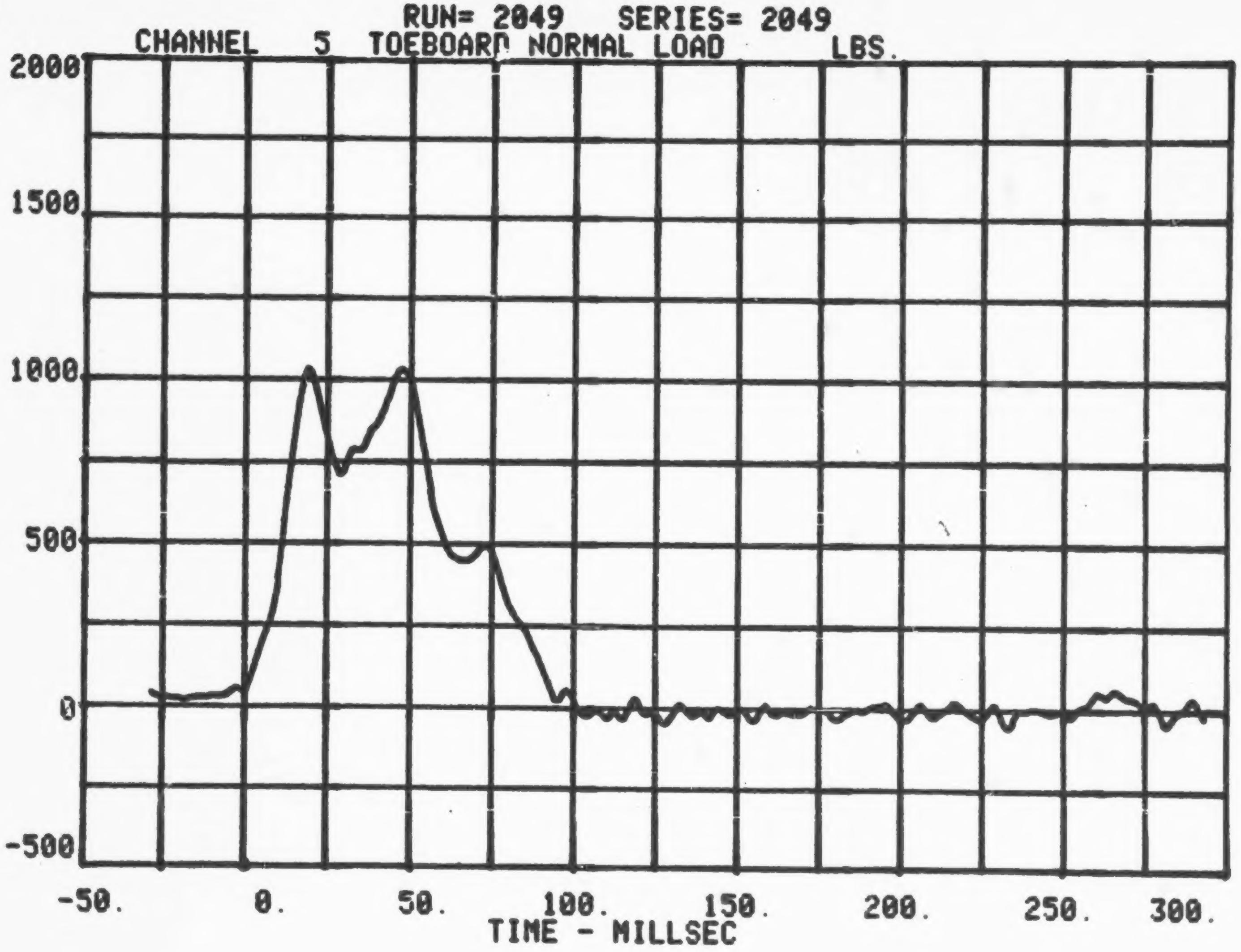


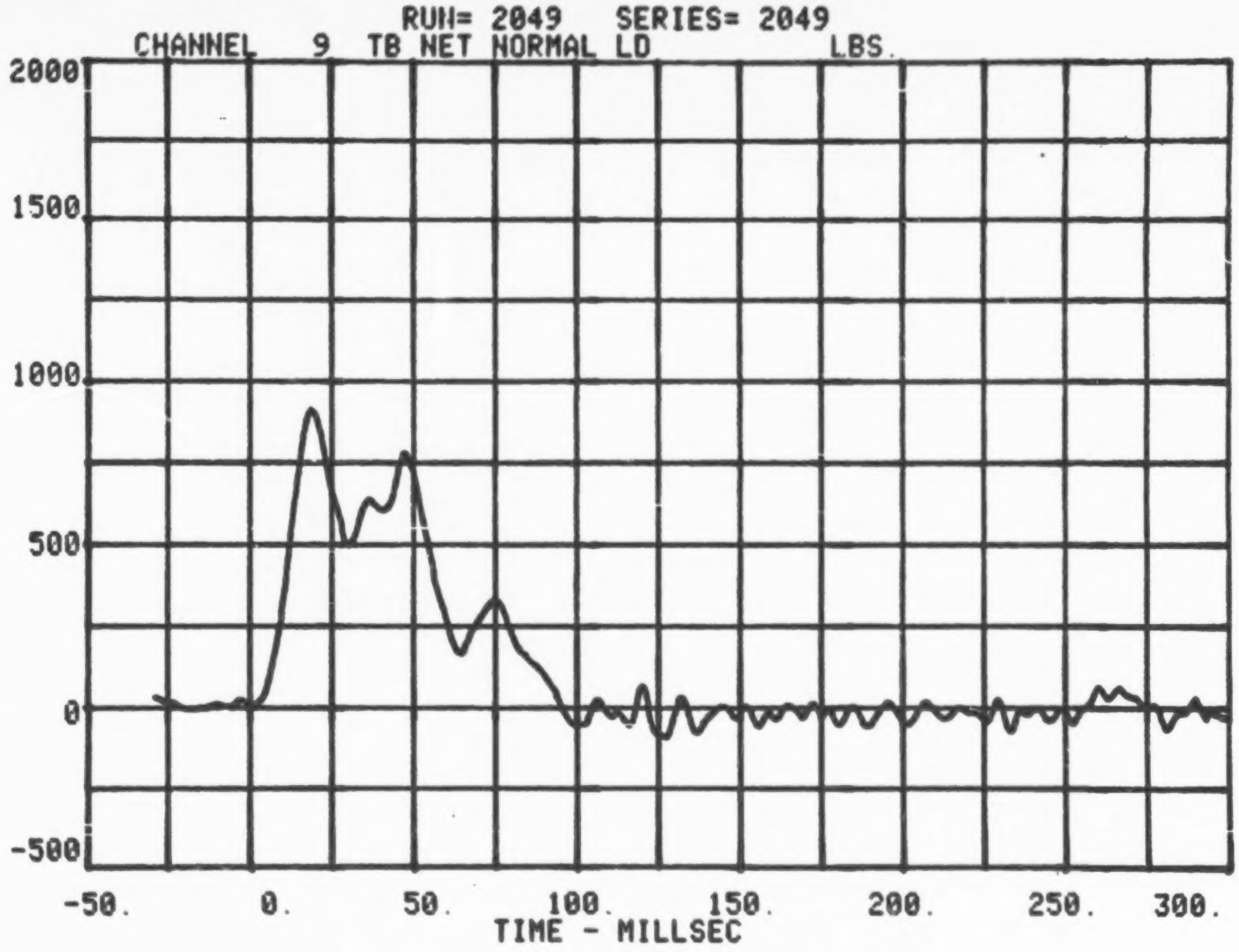
RUN= 2049 SERIES= 2049

CHANNEL 32 TOEBOARD UPPER CTR N. LD LBS.



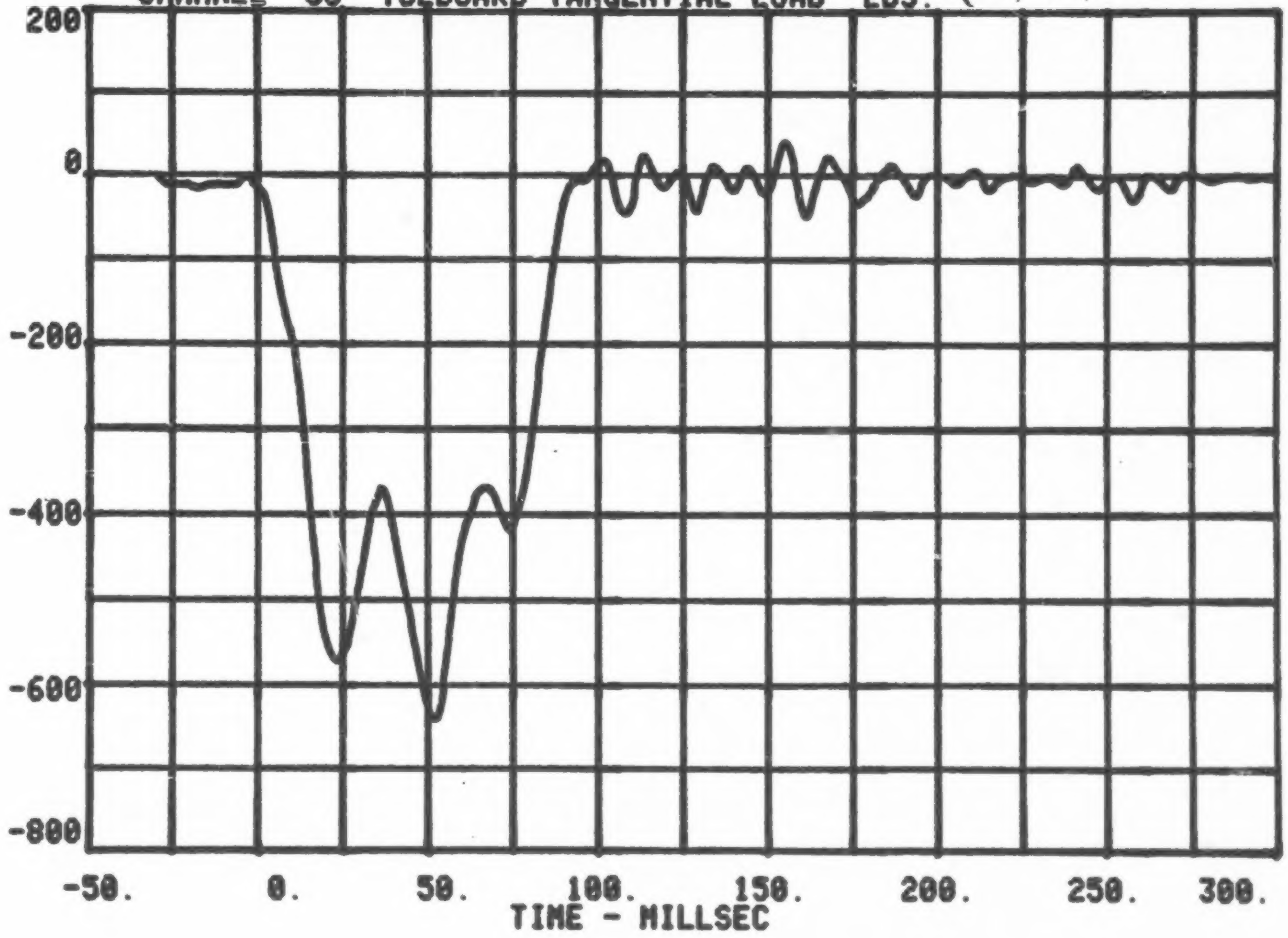
BEST DOCUMENT AVAILABLE

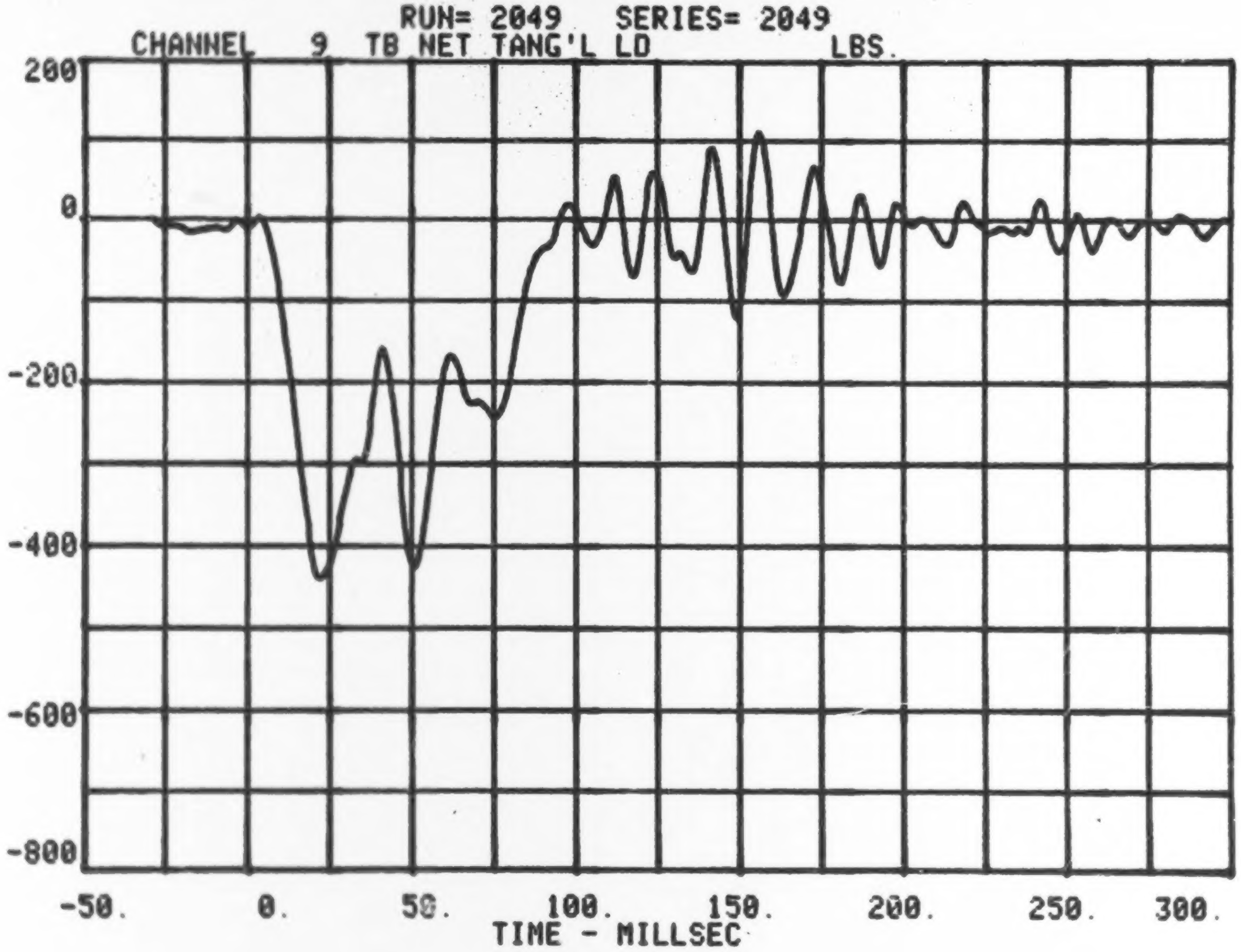

RUN= 2049 SERIES= 2049
CHANNEL 5 TOEBOARD NORMAL LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

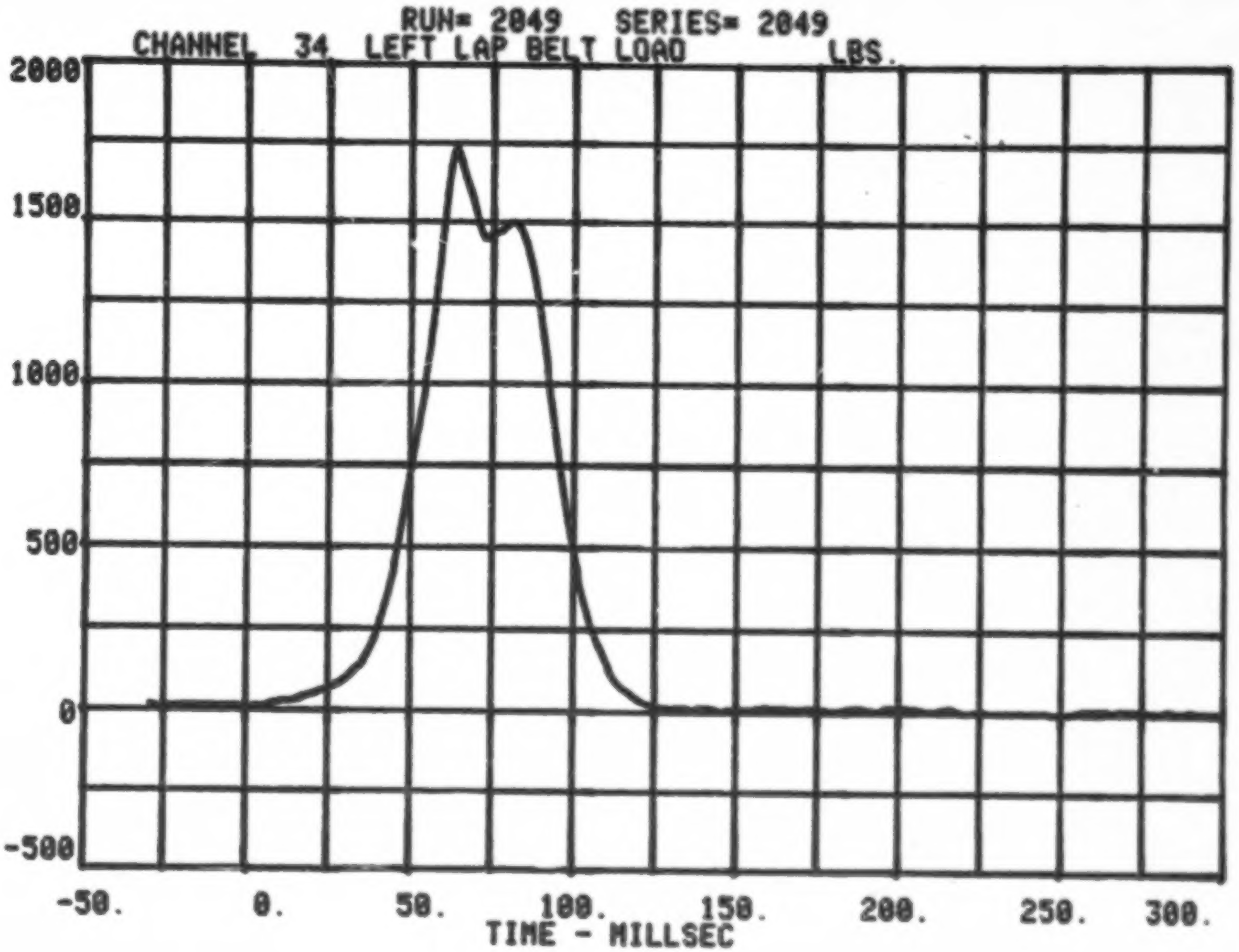


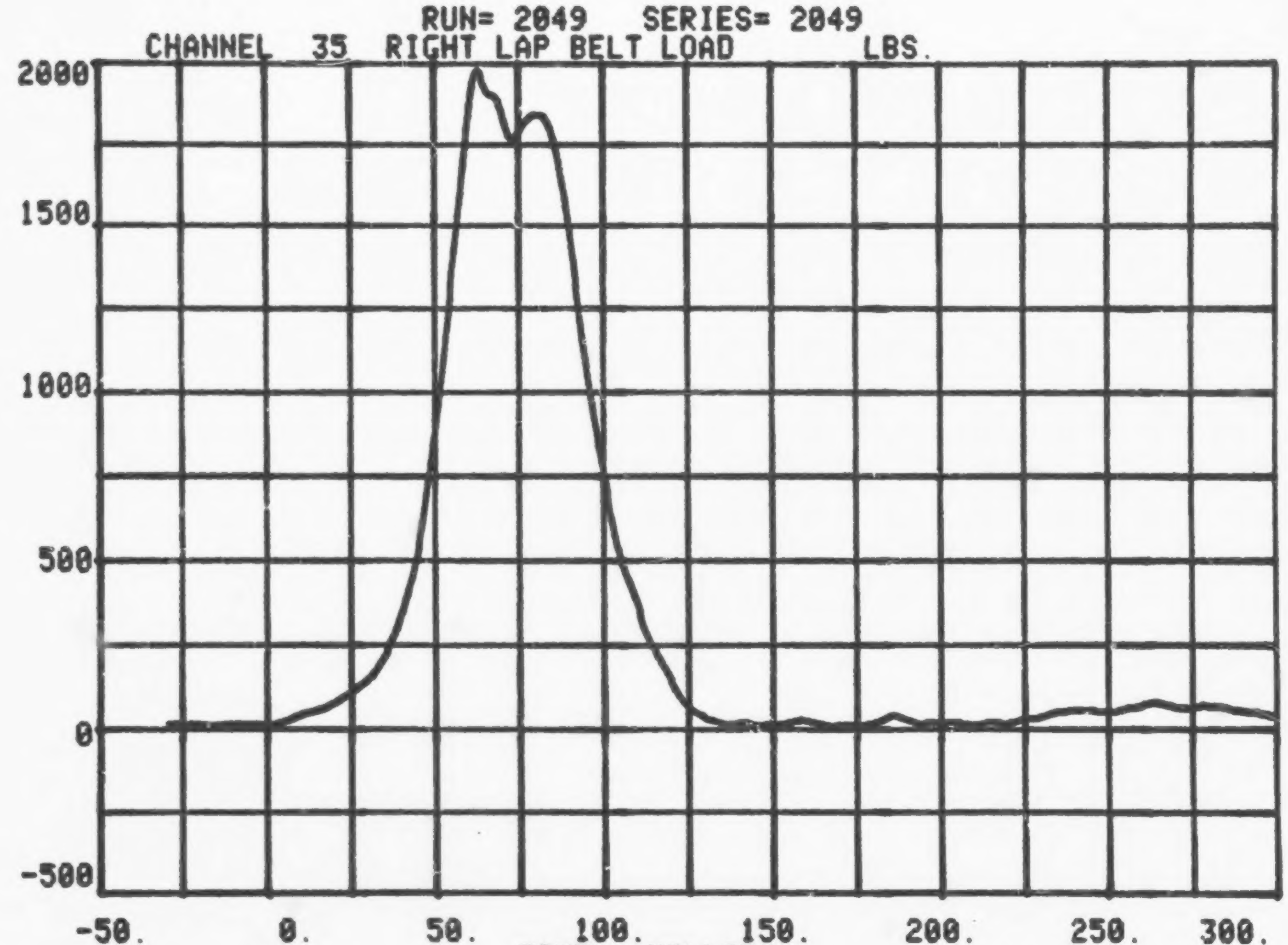
BEST DOCUMENT AVAILABLE

RUN= 2049 SERIES= 2049
CHANNEL 33 TOEBOARD TANGENTIAL LOAD LBS.



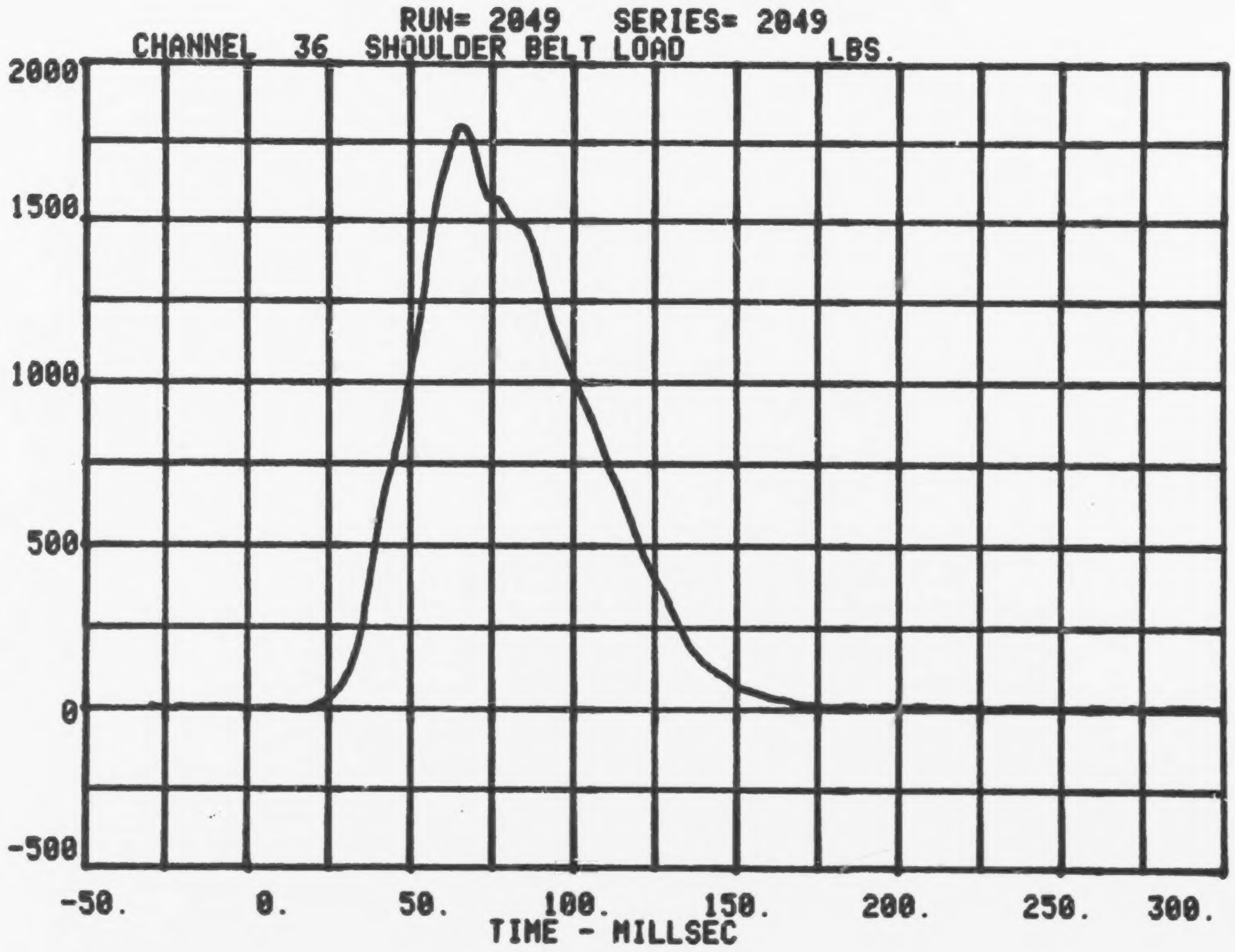

RUN= 2049 SERIES= 2049
CHANNEL 9 TB NET TANG'L LD LBS.
200
0
-200
-400
-600
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

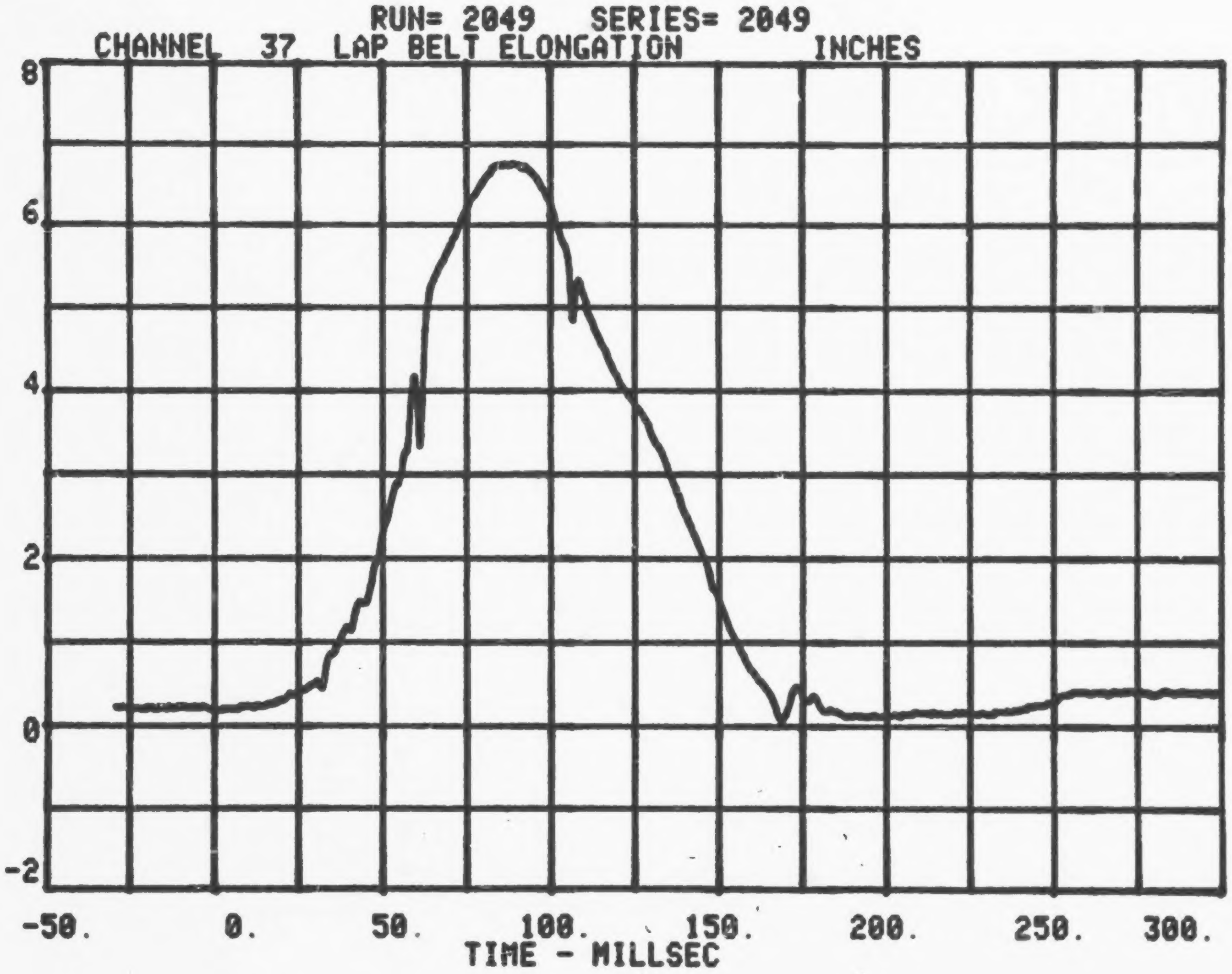

RUN= 2049 SERIES= 2049
CHANNEL 34 LEFT LAP BELT LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



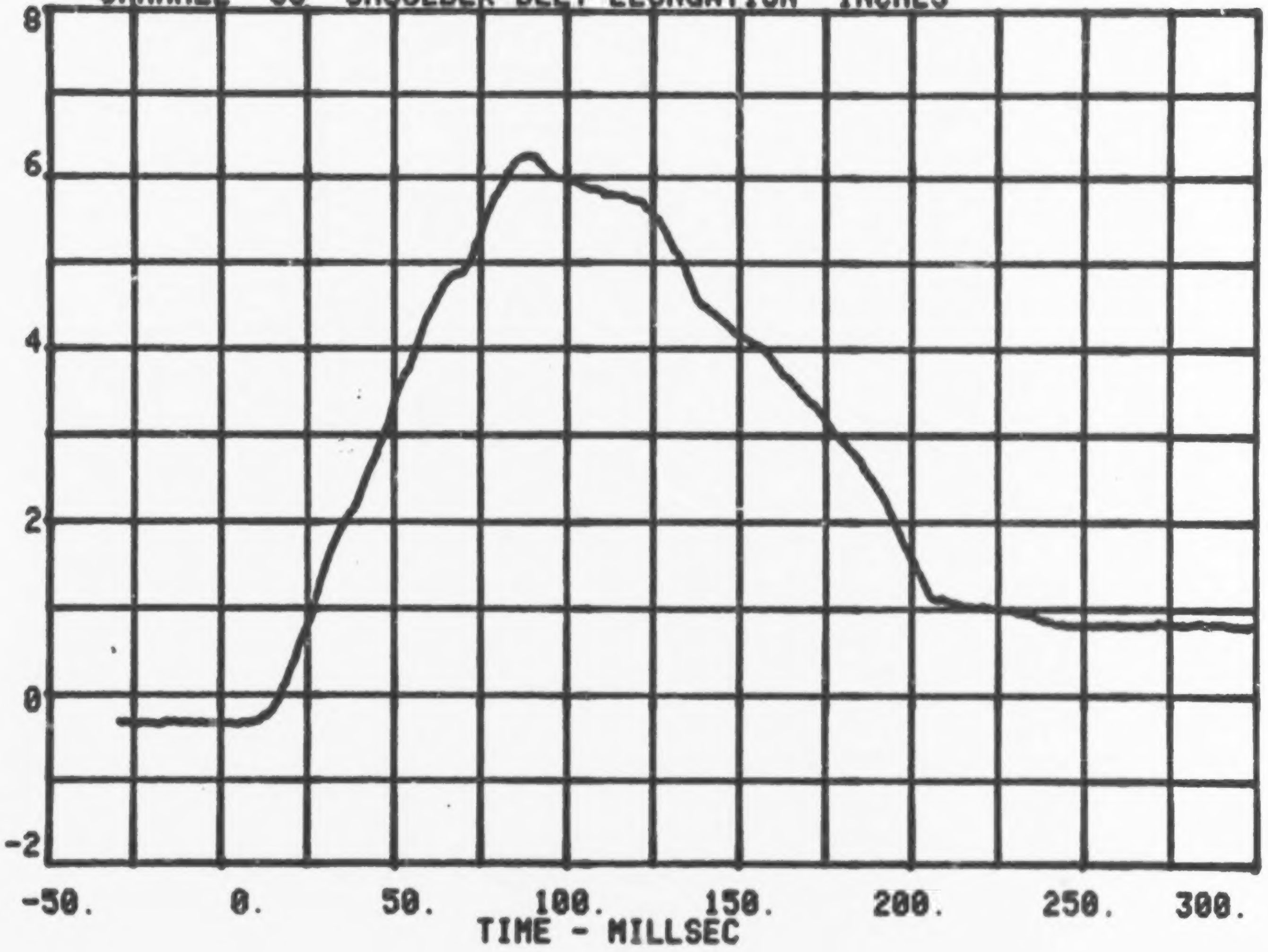
RUN= 2049 SERIES= 2049

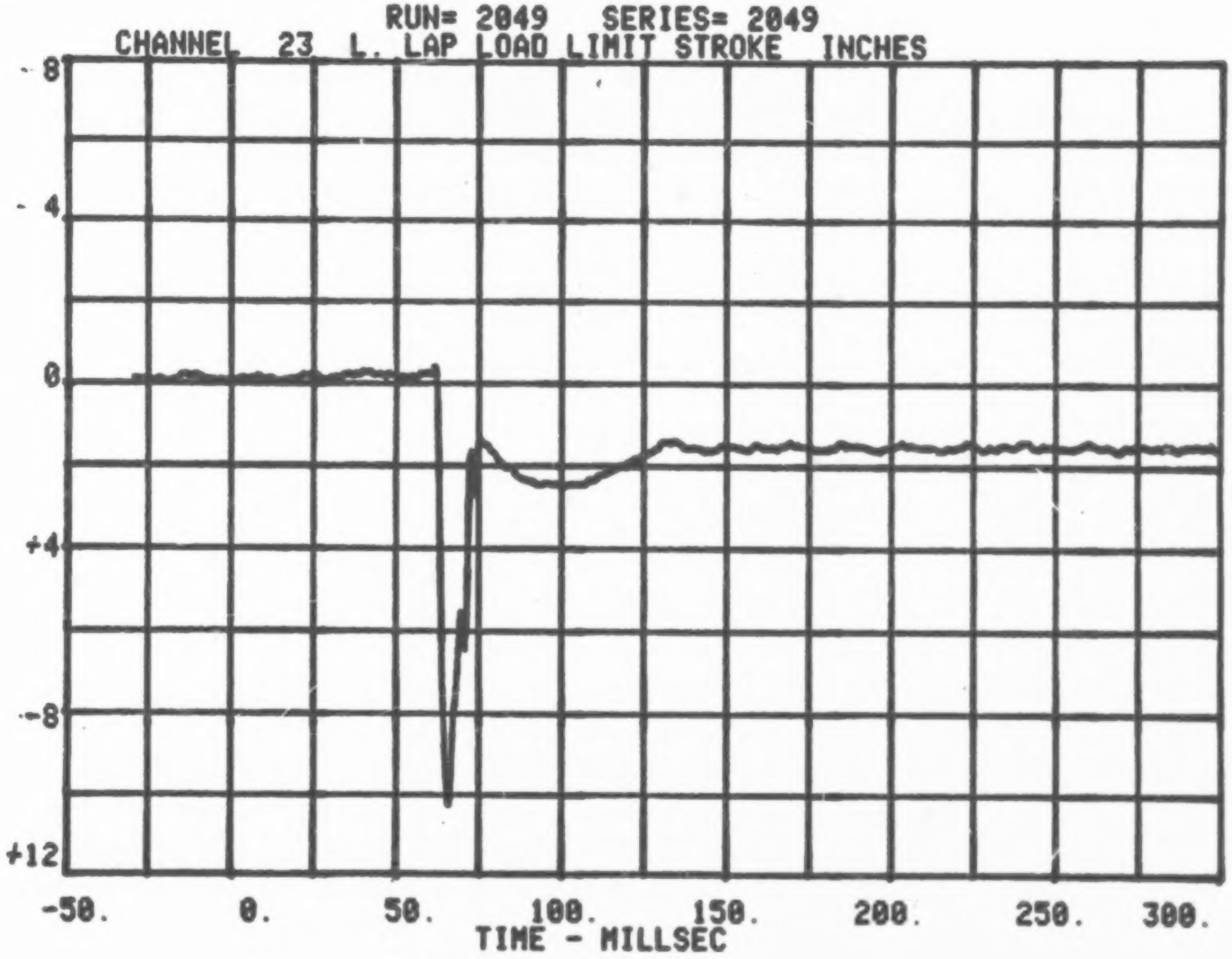
CHANNEL 35 RIGHT LAP BELT LOAD LBS.

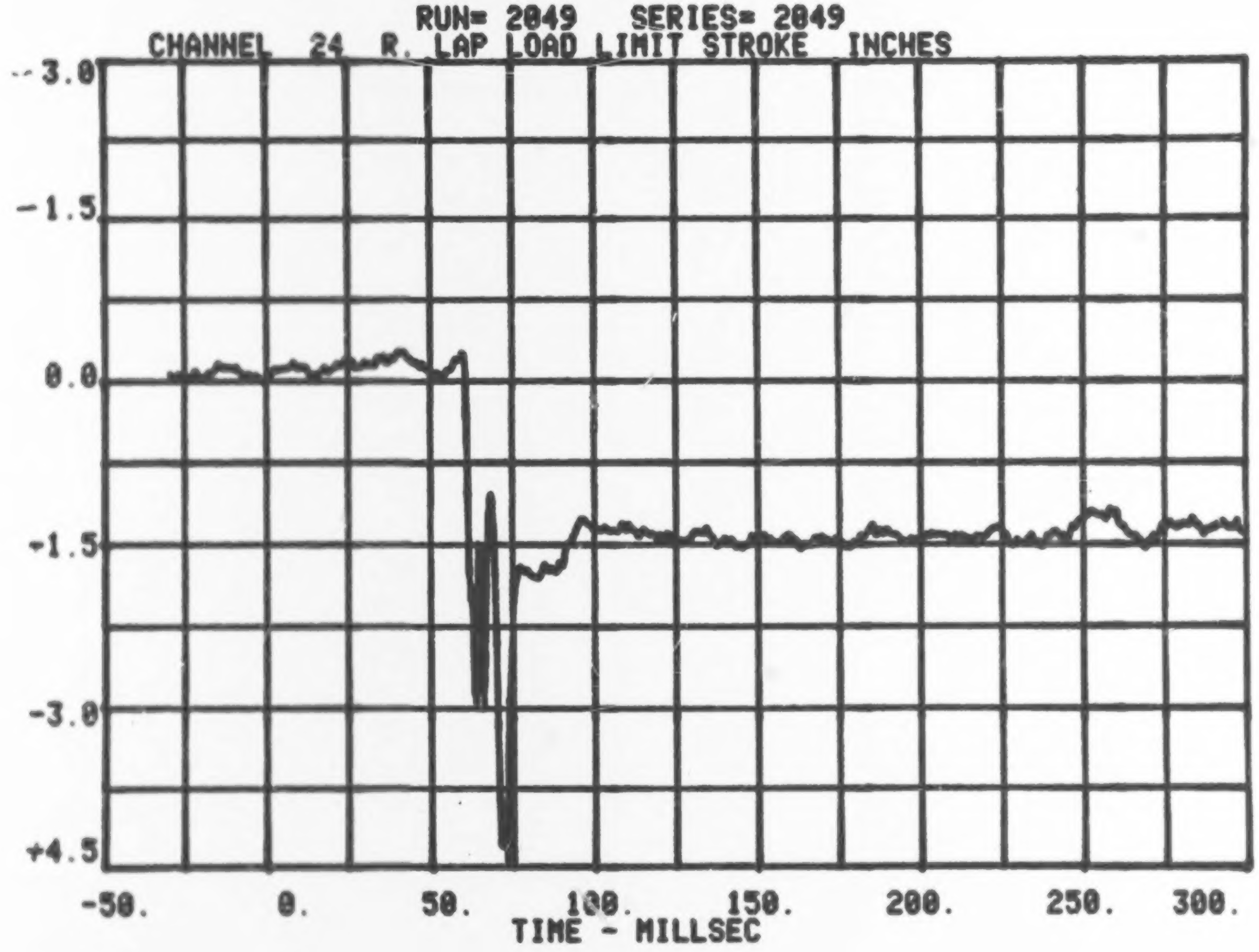

RUN= 2049 SERIES= 2049
CHANNEL 36 SHOULDER BELT LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2049 SERIES= 2049
CHANNEL 37 LAP BELT ELONGATION INCHES
8
6
4
2
0
-2
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

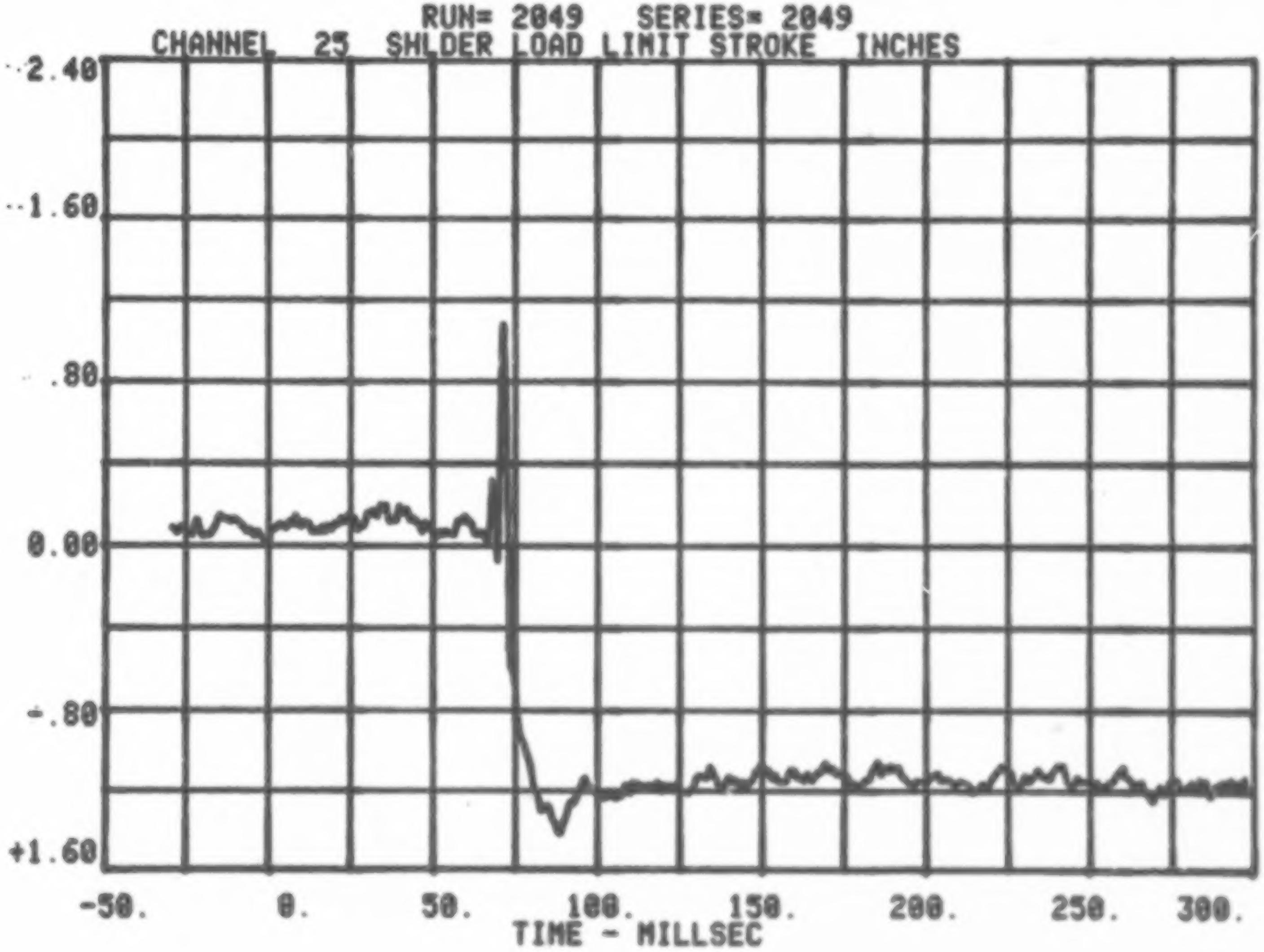
BEST DOCUMENT AVAILABLE


RUN= 2049 SERIES= 2049
CHANNEL 38 SHOULDER BELT ELONGATION INCHES

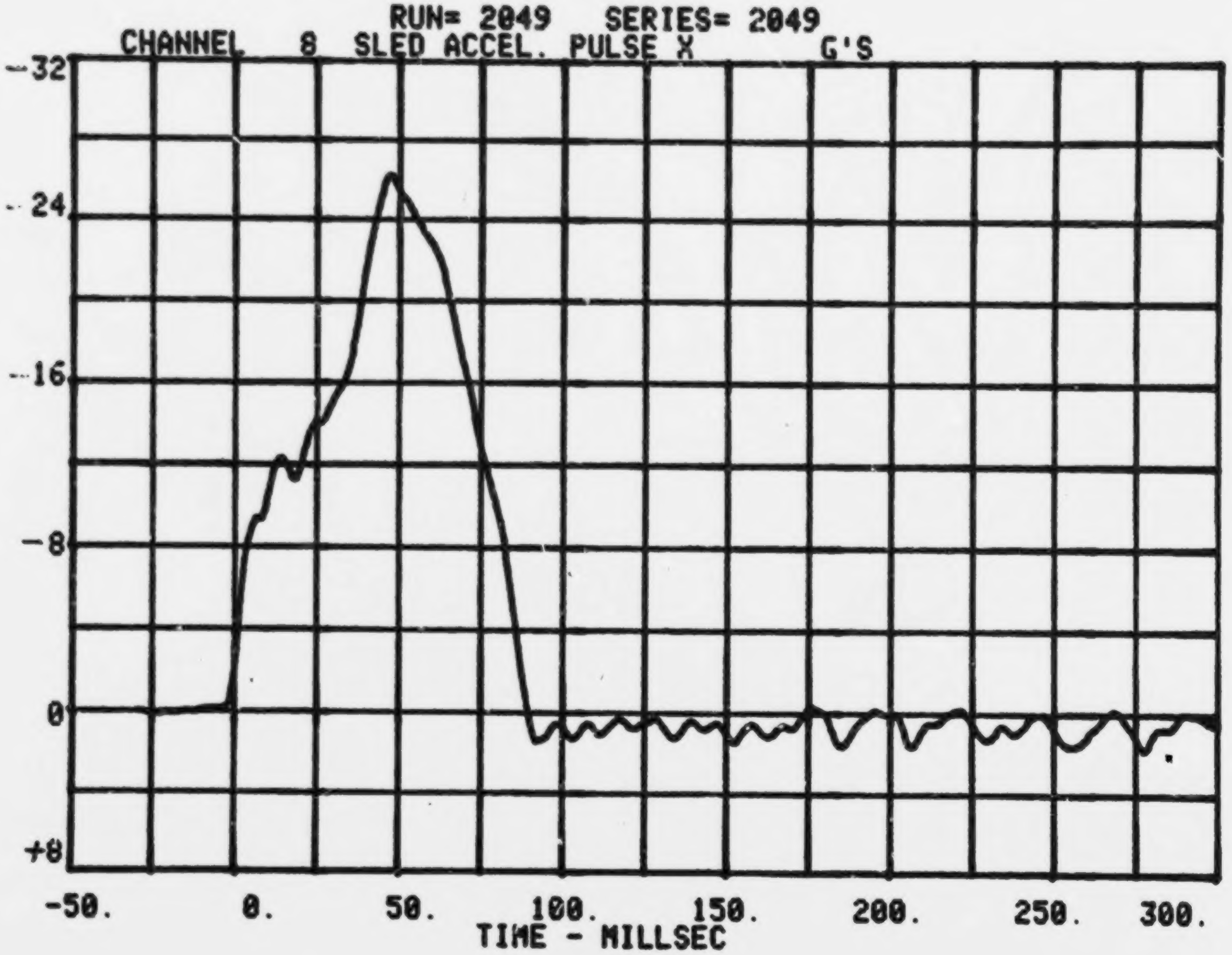

RUN= 2049 SERIES= 2049
CHANNEL 23 L. LAP LOAD LIMIT STROKE INCHES



BEST DOCUMENT AVAILABLE



BEST DOCUMENT AVAILABLE


RUN= 2049 SERIES= 2049
CHANNEL 8 SLED ACCEL. PULSE X G'S
-32
-24
-16
-8
0
+8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

APPENDIX G

BELT RESTRAINT SLED TEST 2050 DATA RECORDS

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Pelvis Accelerations	180
Arm Accelerations	180
Femur Loads	600
Contact Panel Loads	60
Belt Loads	60
Belt Elongations	180
Load Limiter Strokes	180
Sled Acceleration	60

Sequence of Data Records

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Pelvis - X, Y, Z, Resultant Accelerations

Left Arm - X, Y, Z, Resultant Accelerations

Right Arm - X, Y, Z, Resultant Accelerations

Seat Normal Load - Front Left, Front Right, Rear, Gross Sum, Net Sum

Seat Tangential Load - Gross, Net

Toeboard Normal Load - Lower Left, Lower Right, Upper Center, Gross Sum, Net Sum

Toeboard Tangential Load - Gross, Net

Belt Load - Left Lap, Right Lap, Shoulder

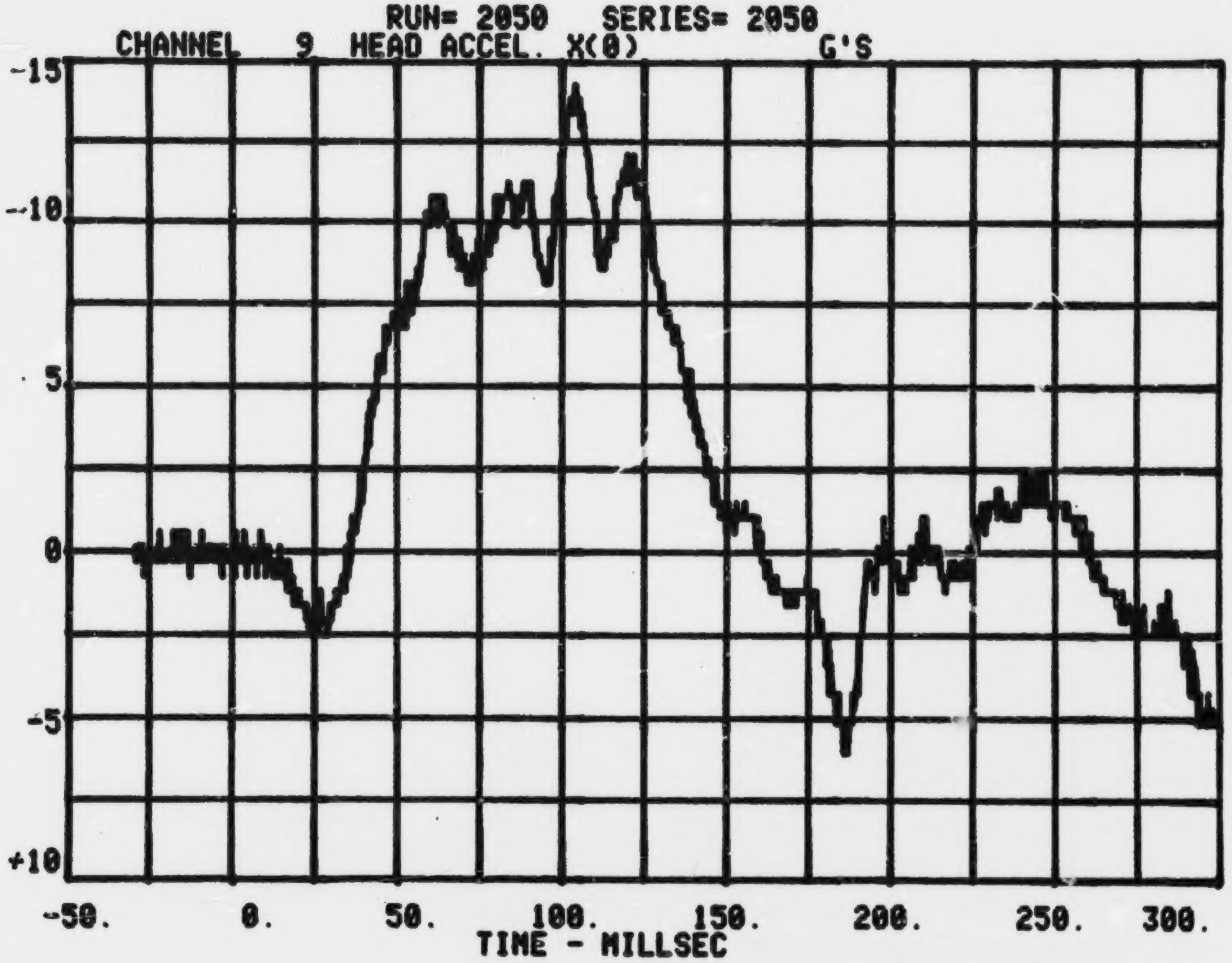
Belt Elongation - Lap, Shoulder

Belt Load Limiter Stroke - Left Lap, Right Lap, Shoulder

Sled Acceleration

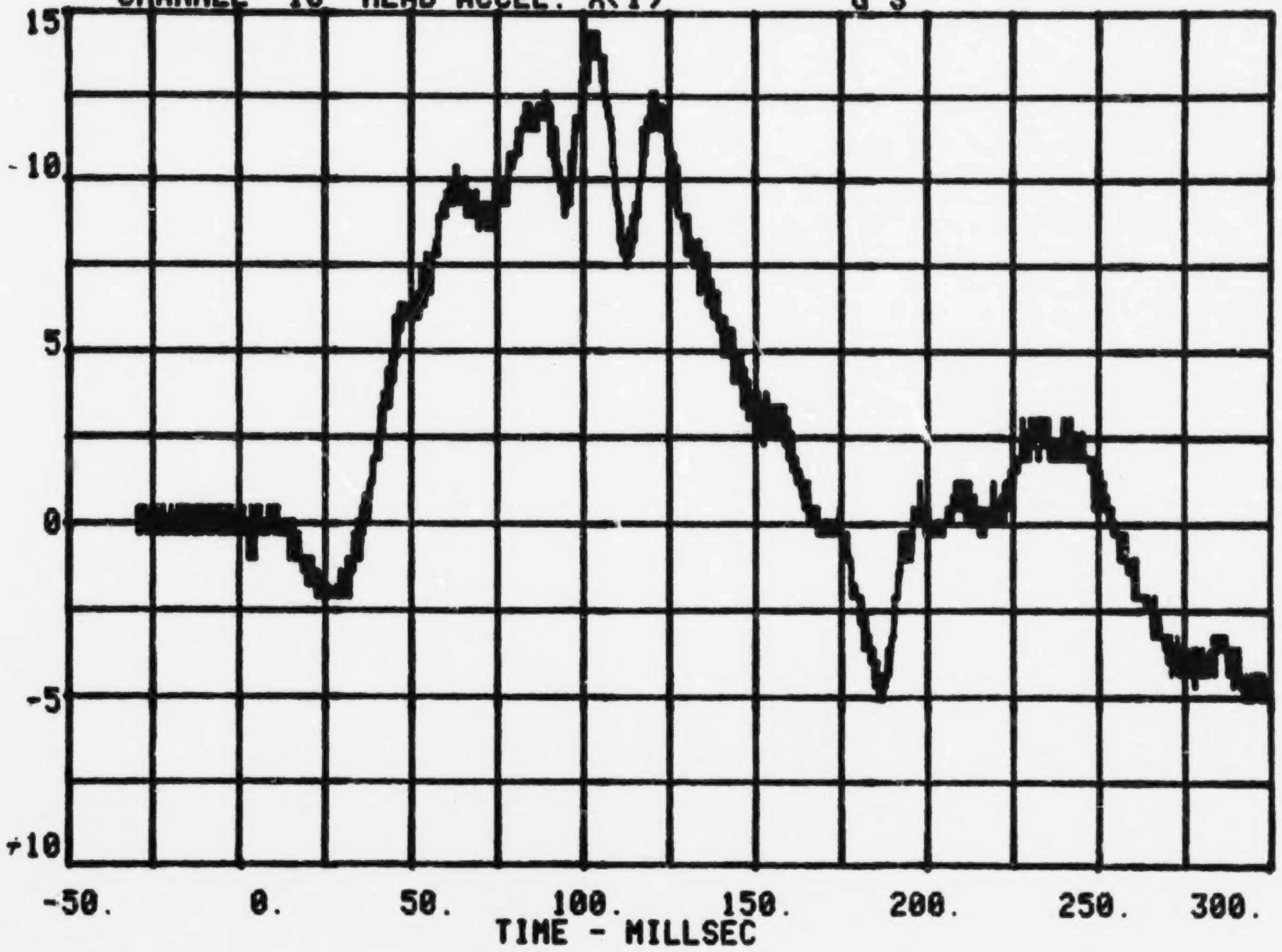
```
                    HEAD INJURY CRITERION
                     HEAD SEVERITY INDEX

               SLED TEST #2050

               RUN=2050

               RESULT. HEAD ACCEL.

HIC= 251.2   FROM T1= .04920   TO T2= .12300

AVERAGE ACCELERATION BETWEEN T1 AND T2=  25.9G'S

EVENT TIME= 300.0  MSEC

SEVERITY INDEX= 319.6
```

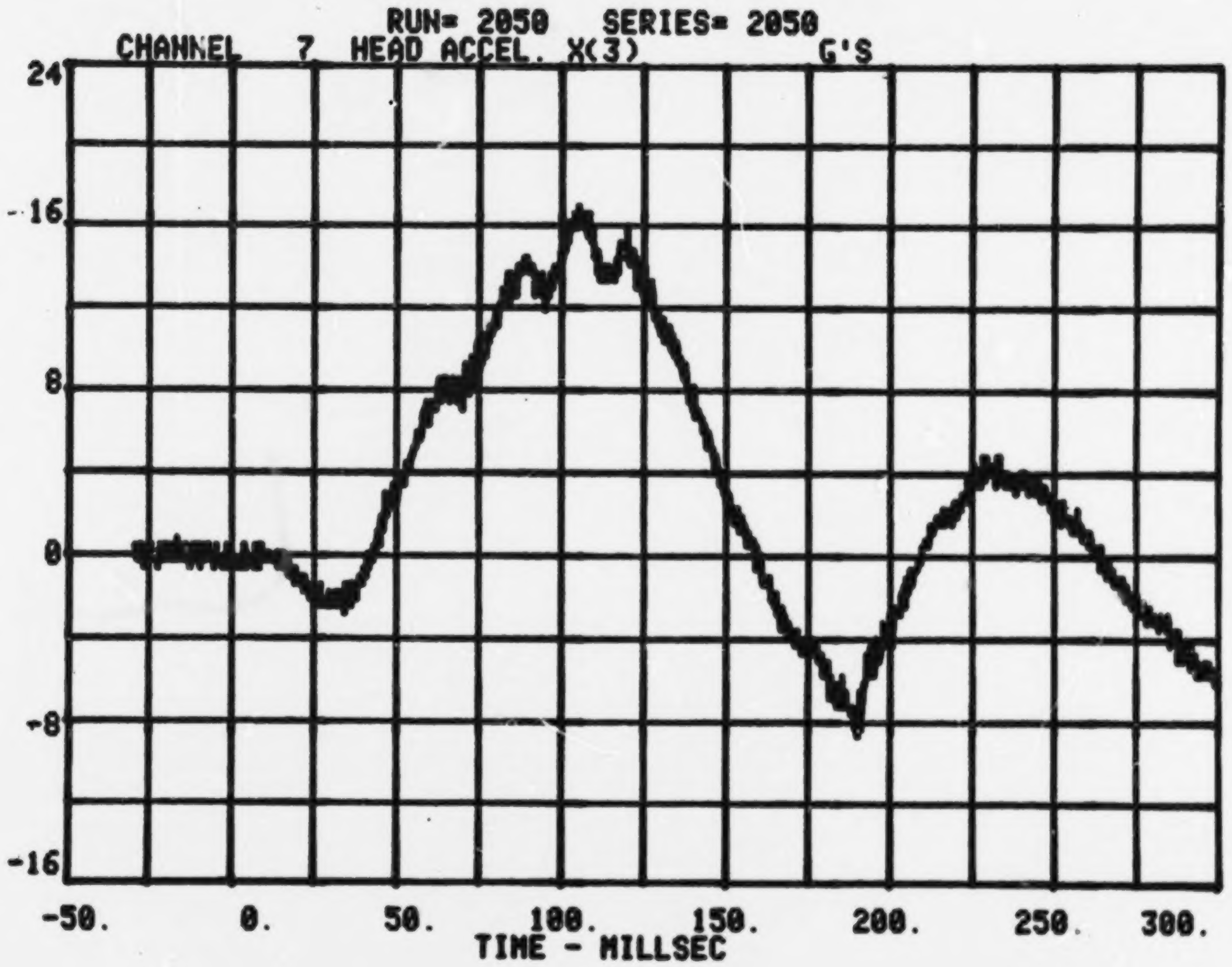
BEST DOCUMENT AVAILABLE

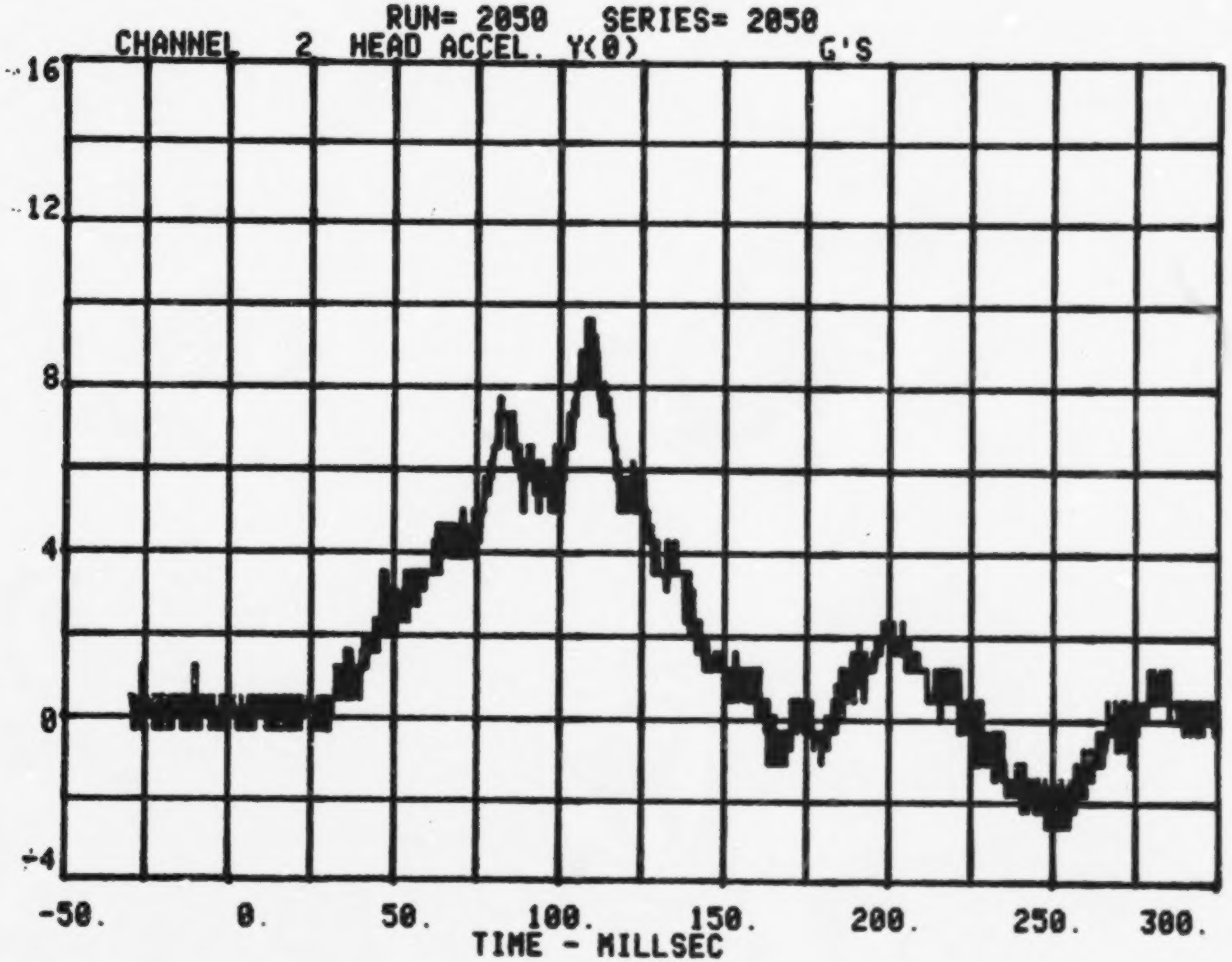


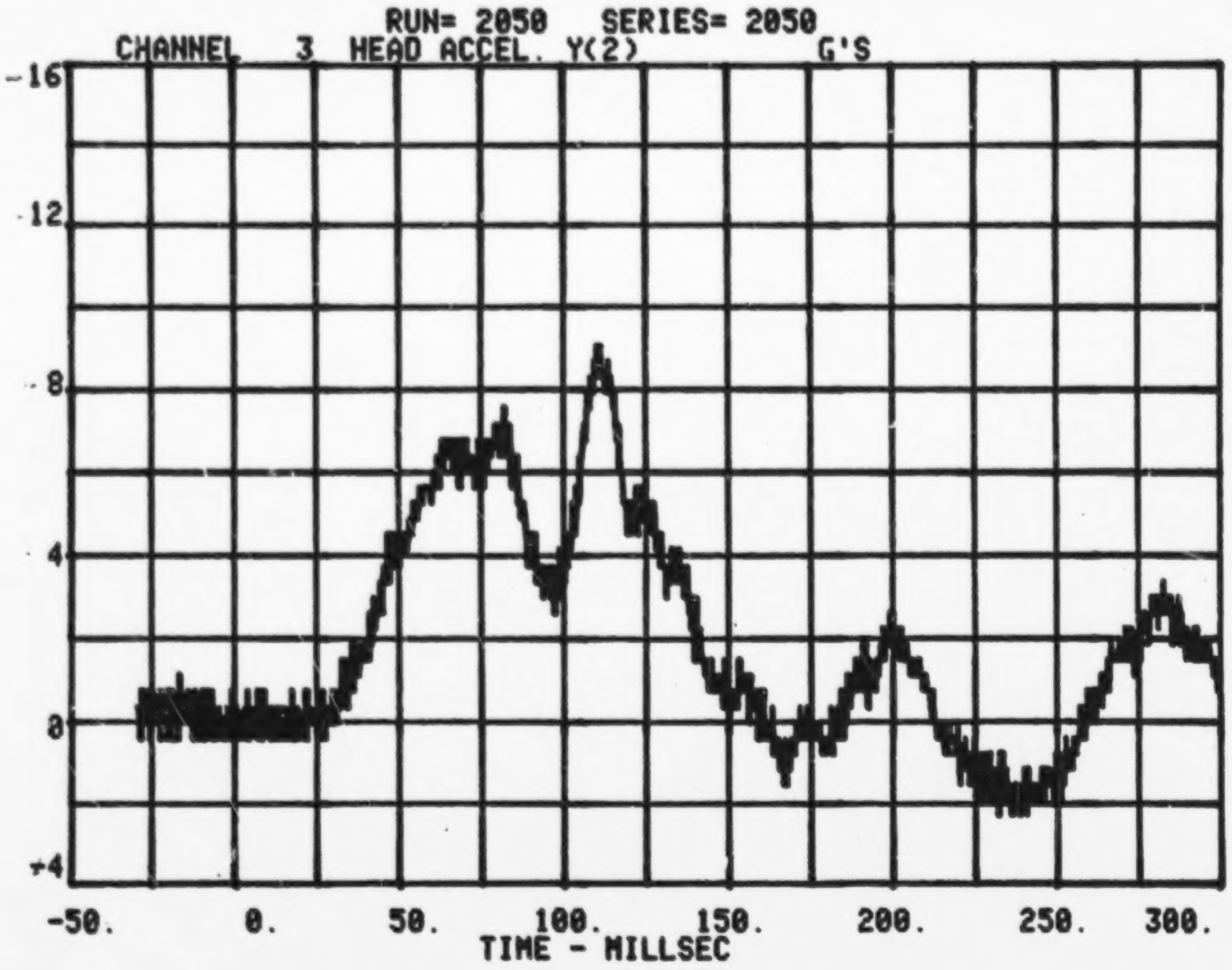
RUN= 2050 SERIES= 2050

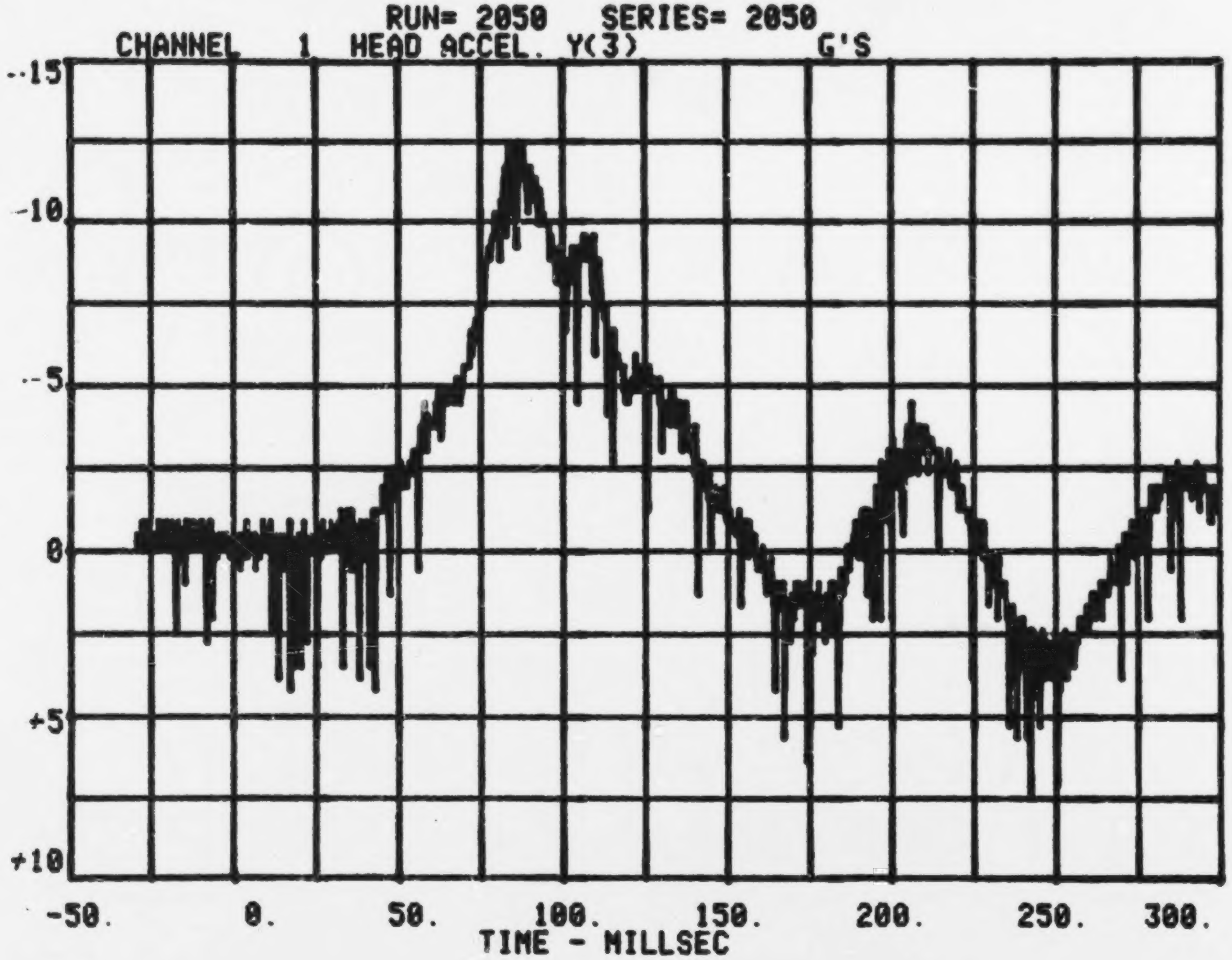
CHANNEL 10 HEAD ACCEL. X(1) G'S

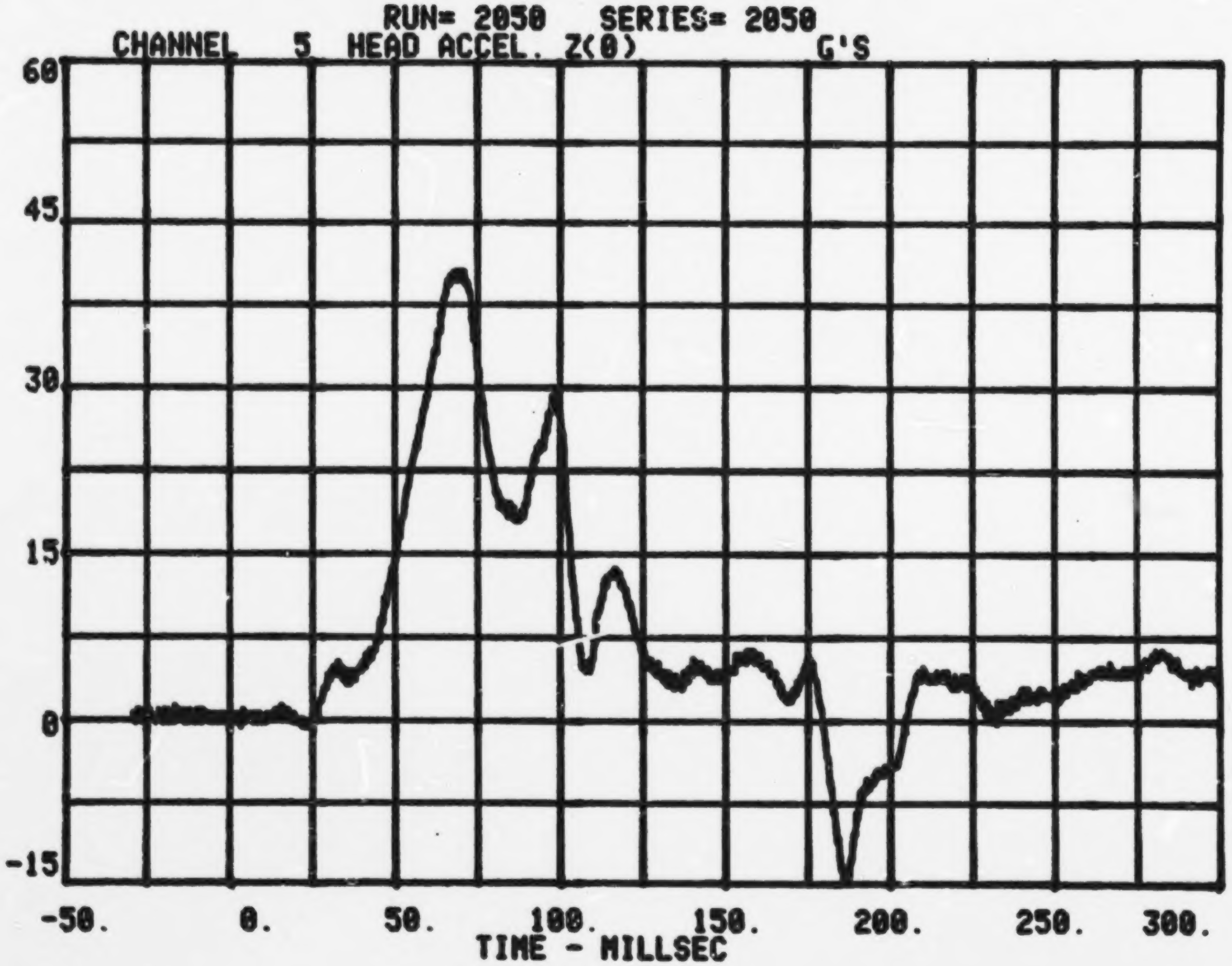


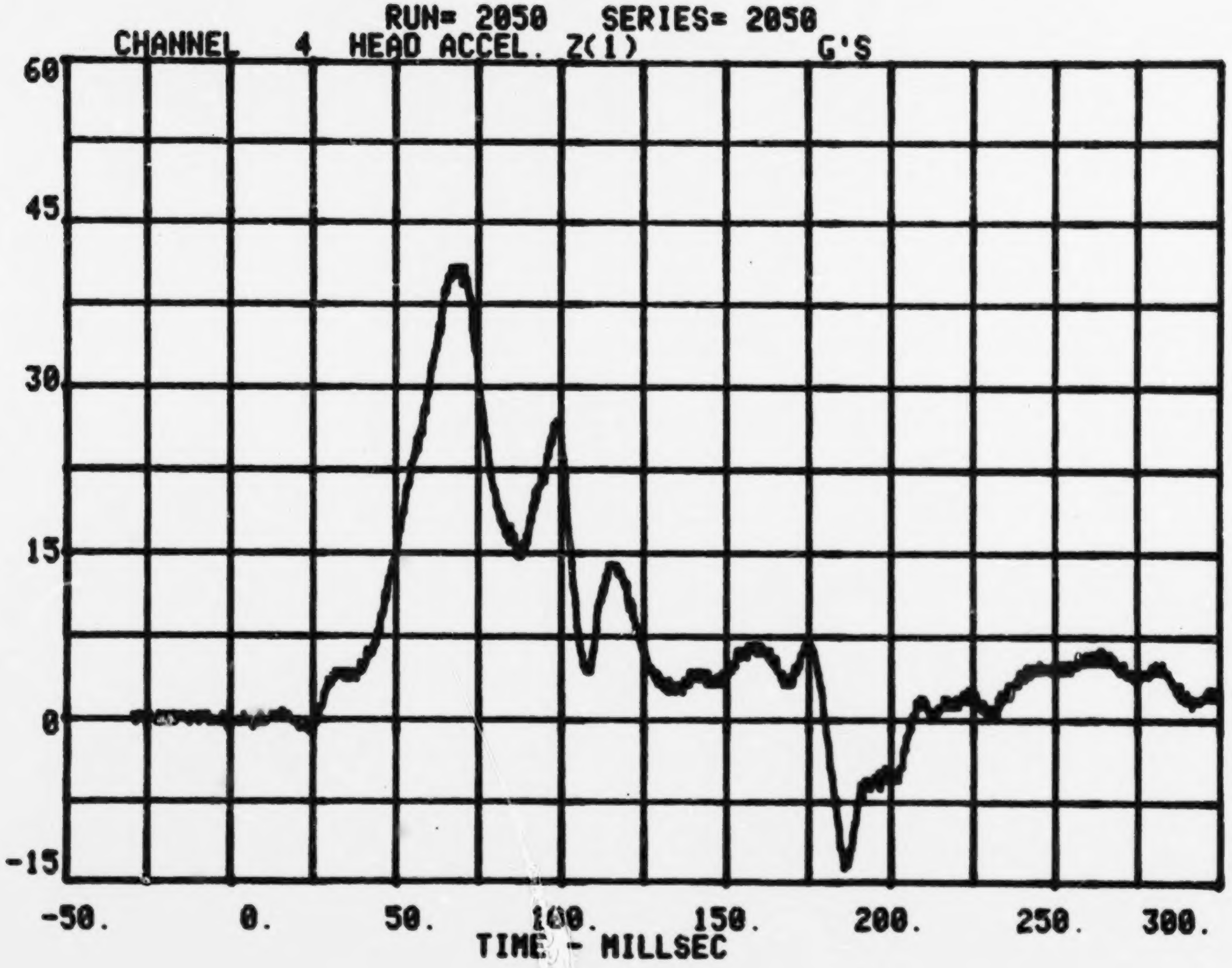

RUN= 2050 SERIES= 2050
CHANNEL 7 HEAD ACCEL. X(3) G'S
24
16
8
0
-8
-16
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

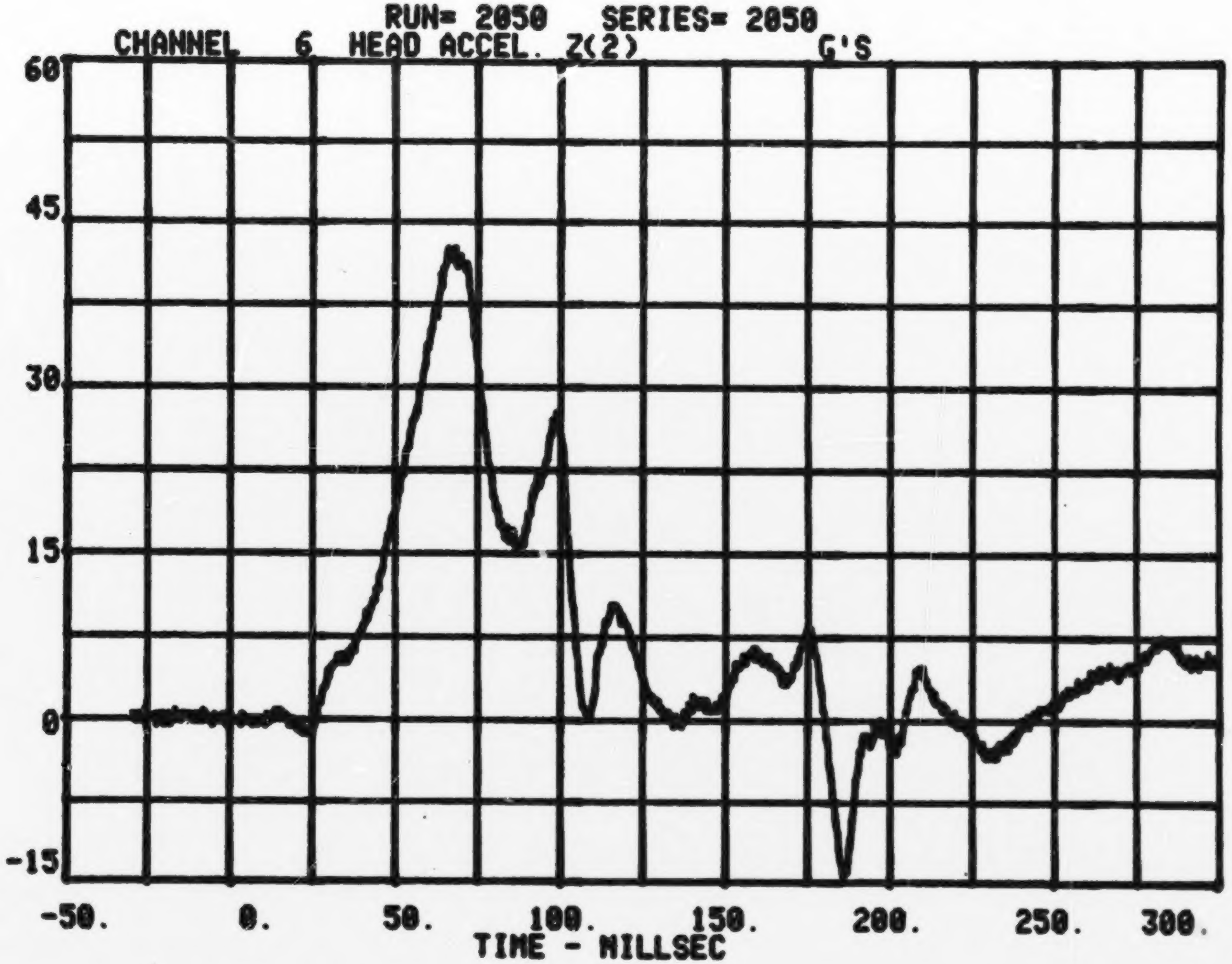

RUN= 2050 SERIES= 2050
CHANNEL 2 HEAD ACCEL. Y(0) G'S
16
12
8
4
0
-4
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

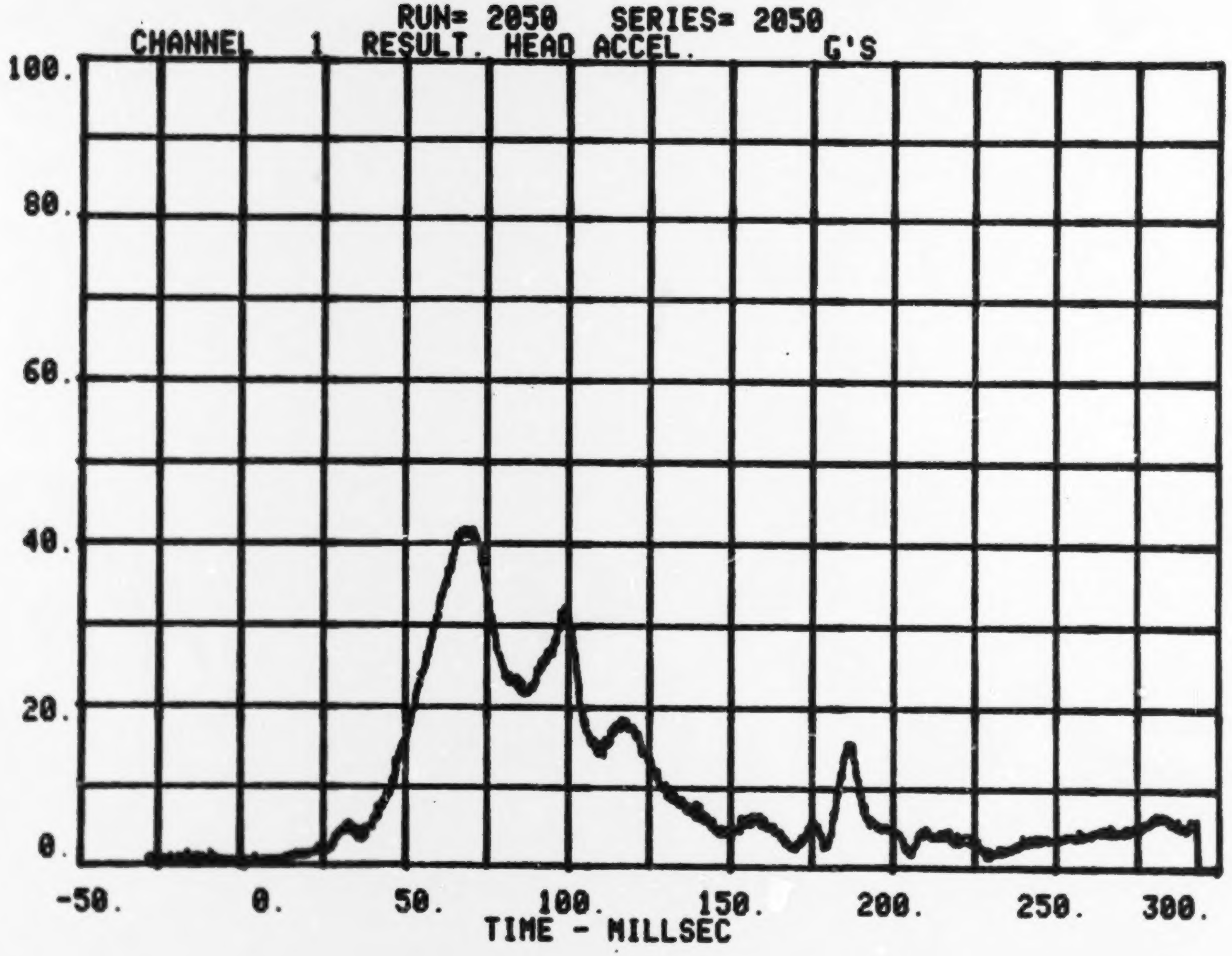

RUN= 2050 SERIES= 2050
CHANNEL 3 HEAD ACCEL. Y(2) G'S
-16
-12
-8
-4
0
+4
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 1 HEAD ACCEL. Y(3) G'S
-15
-10
-5
0
+5
+10
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 5 HEAD ACCEL. Z(0) G'S
60
45
30
15
0
-15
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 4 HEAD ACCEL. Z(1) G'S
60
45
30
15
0
-15
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 6 HEAD ACCEL. Z(2) G'S
60
45
30
15
0
-15
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



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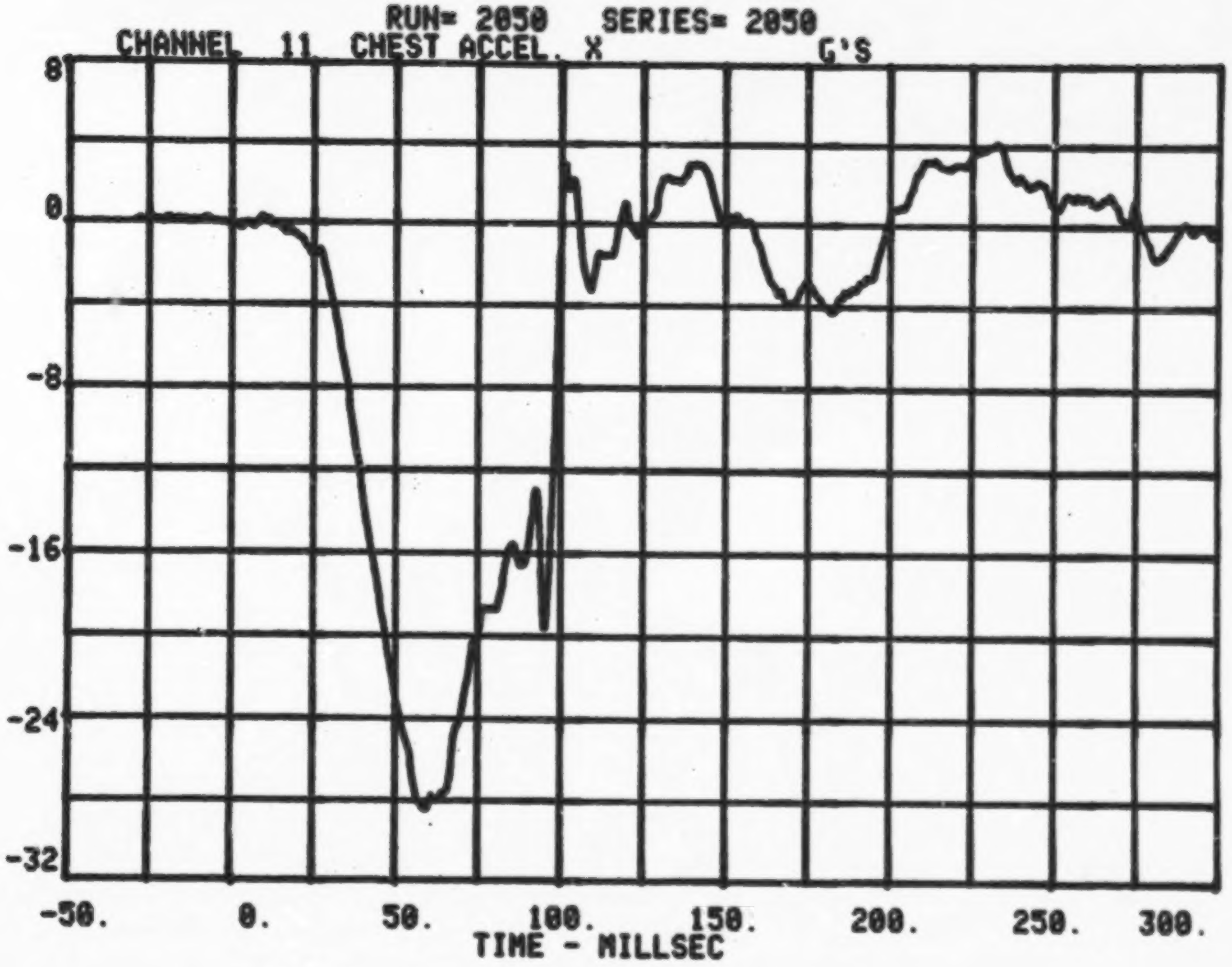
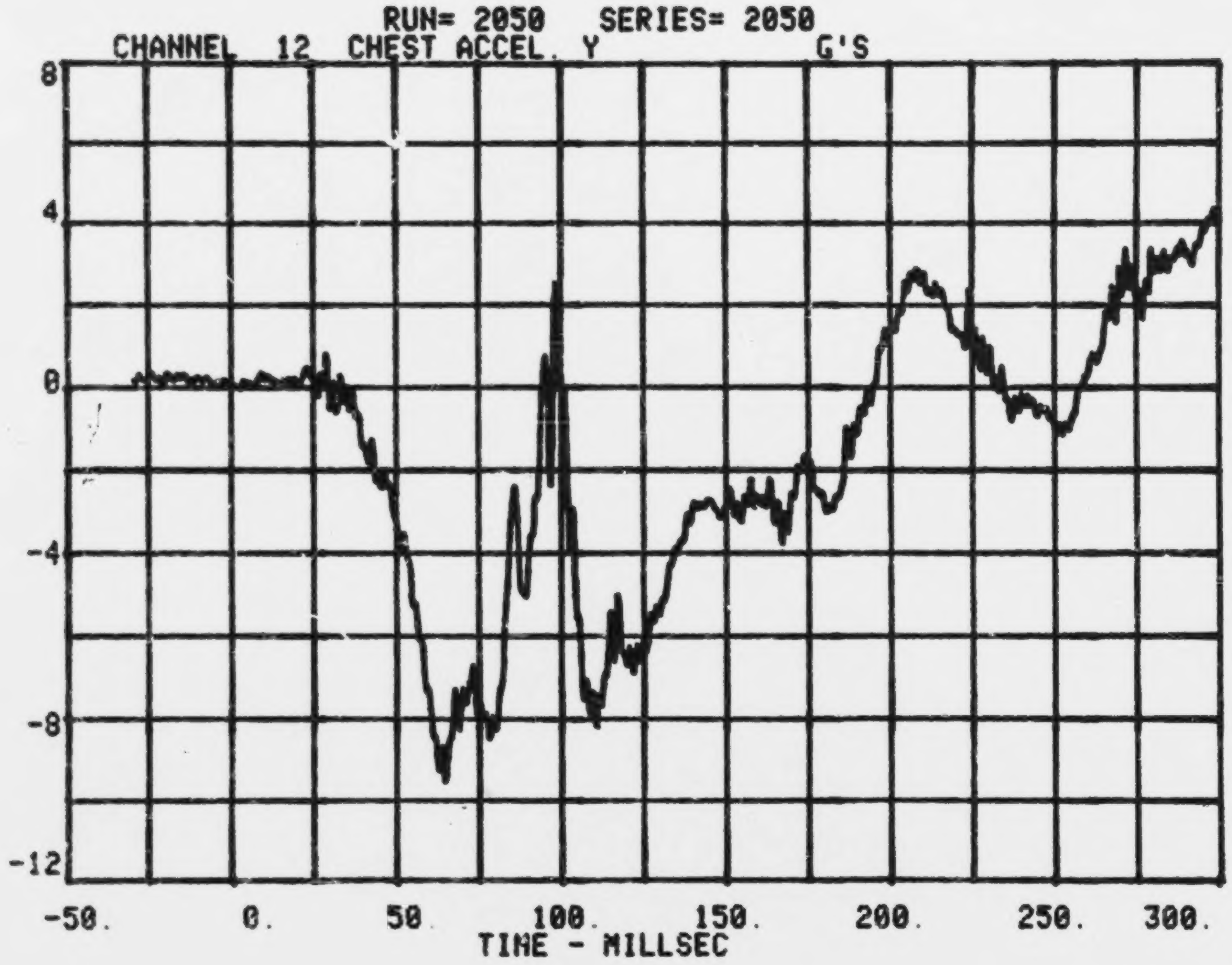
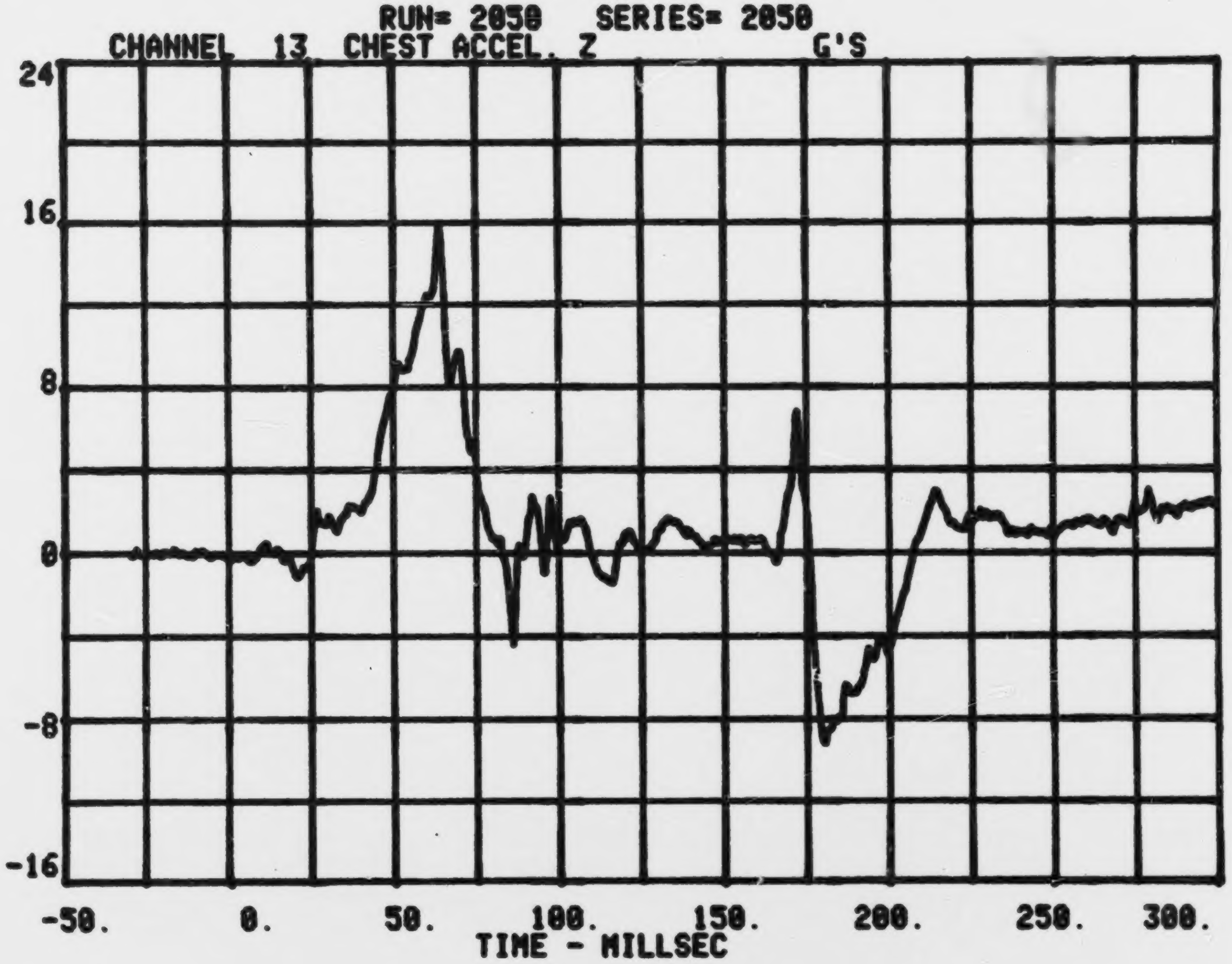
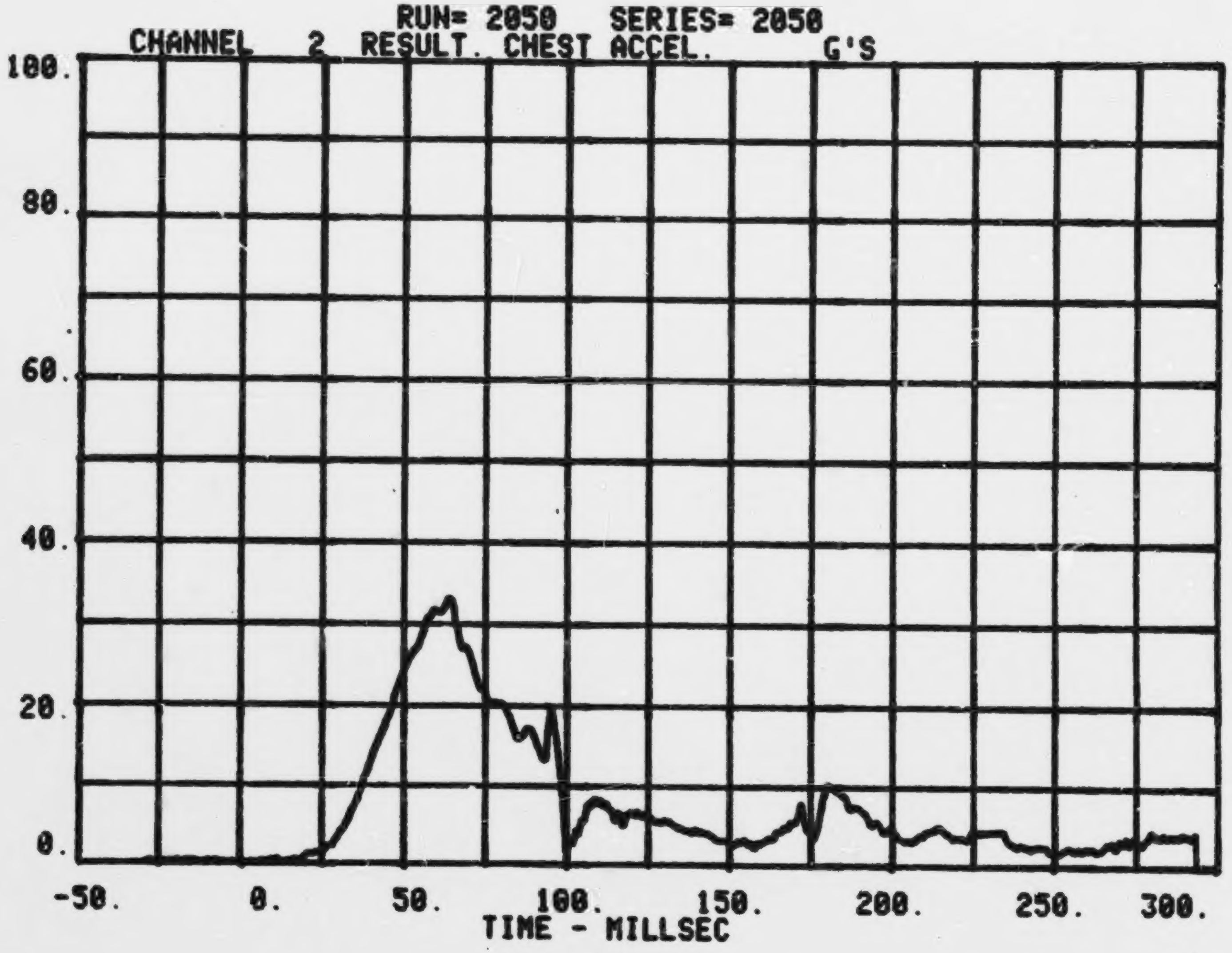

RUN= 2050 SERIES= 2050
CHANNEL 11 CHEST ACCEL. X G'S
8
0
-8
-16
-24
-32
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

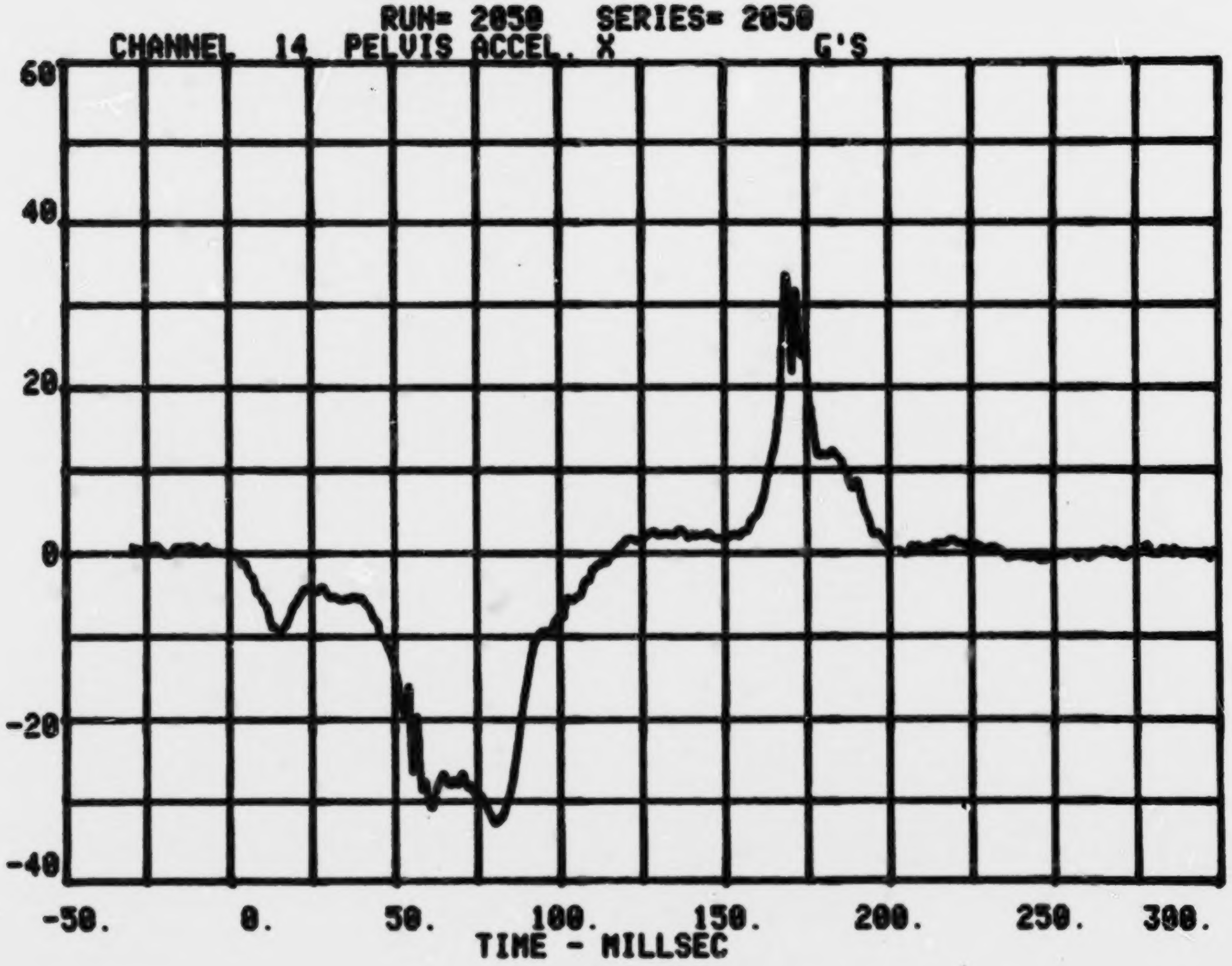

RUN= 2050 SERIES= 2050
CHANNEL 12 CHEST ACCEL. Y
G'S
8
4
0
-4
-8
-12
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

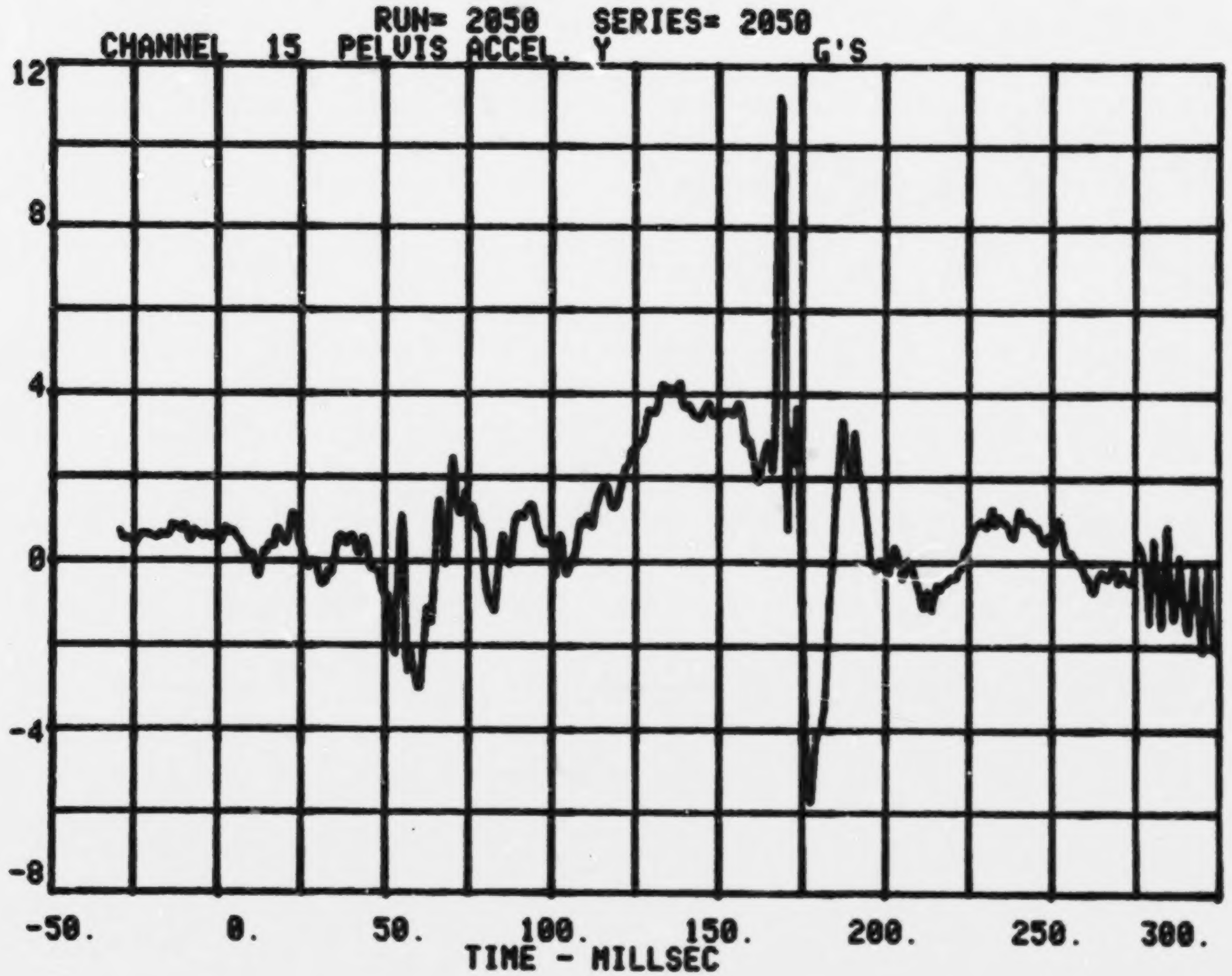
BEST DOCUMENT AVAILABLE

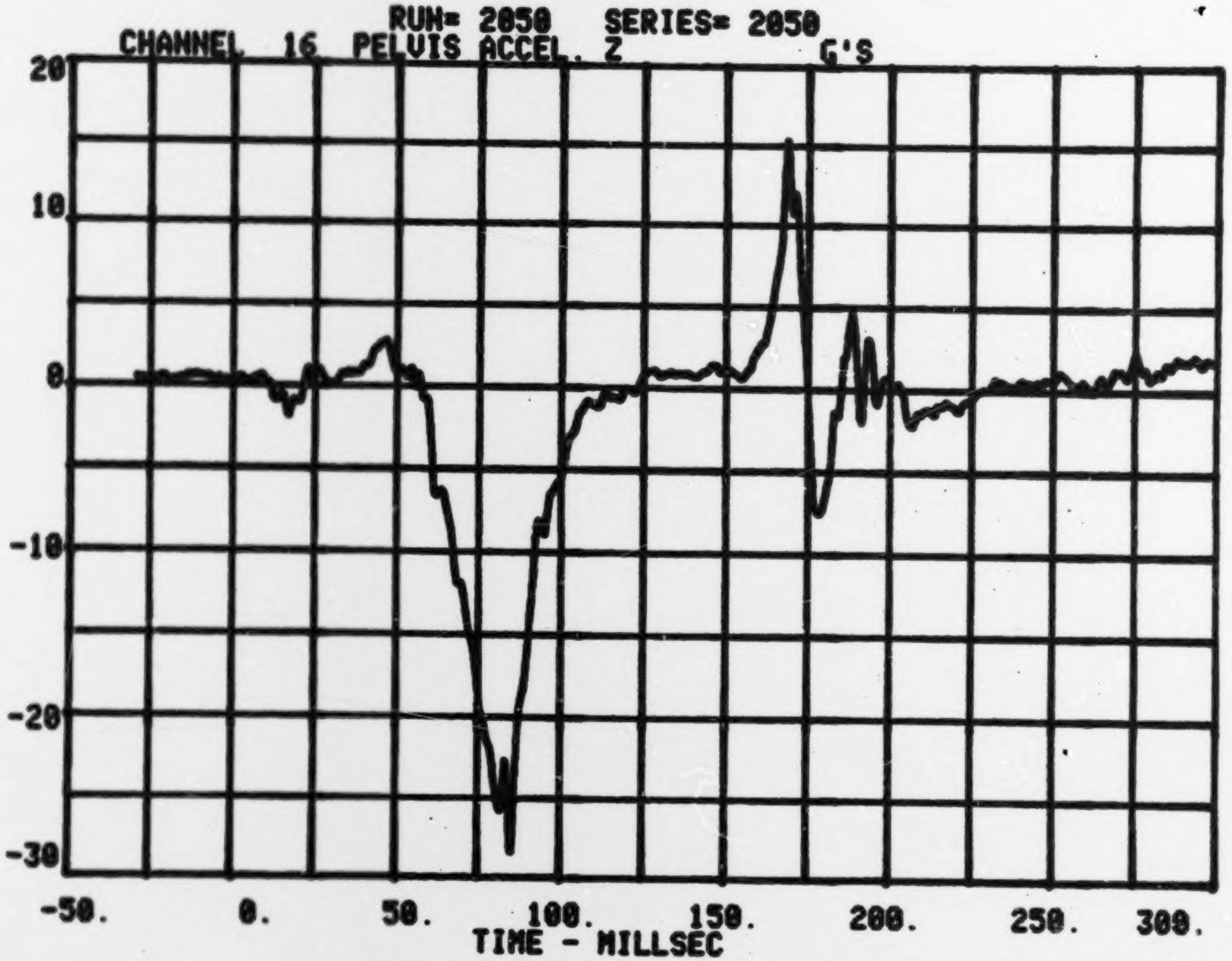


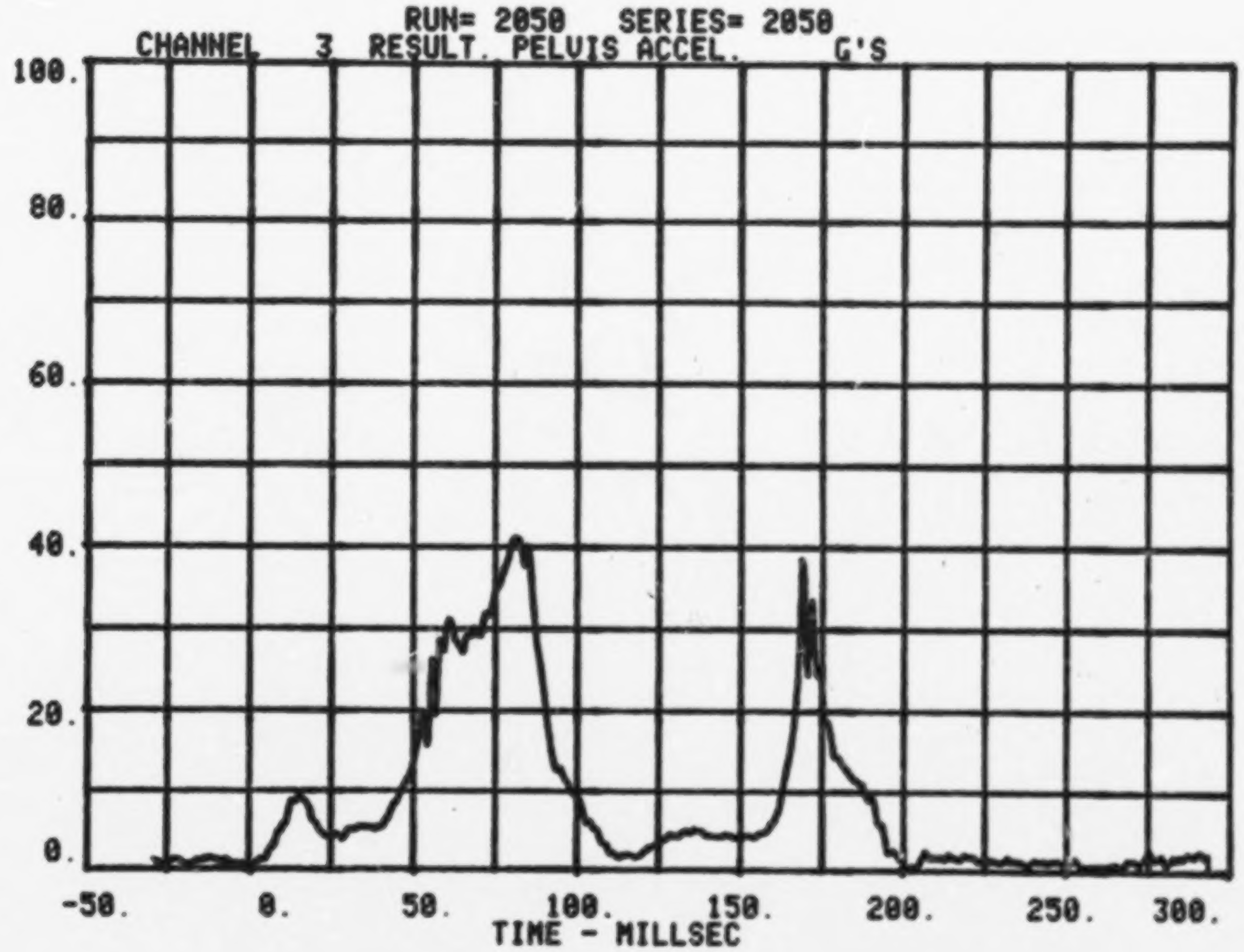

RUN= 2050 SERIES= 2050
CHANNEL 2 RESULT. CHEST ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE

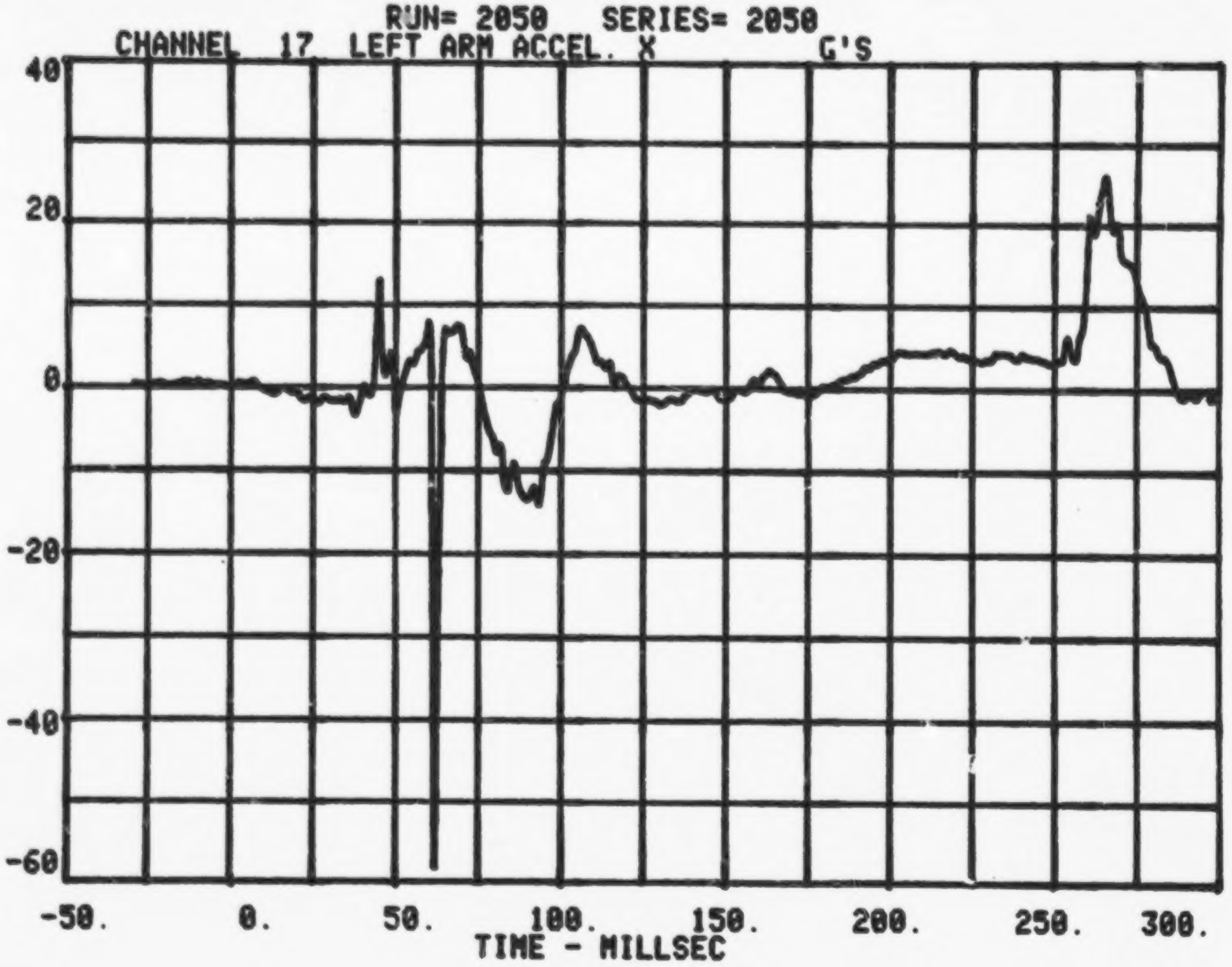



RUN= 2050 SERIES= 2050
CHANNEL 15 PELVIS ACCEL. Y G'S
12
8
4
0
-4
-8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

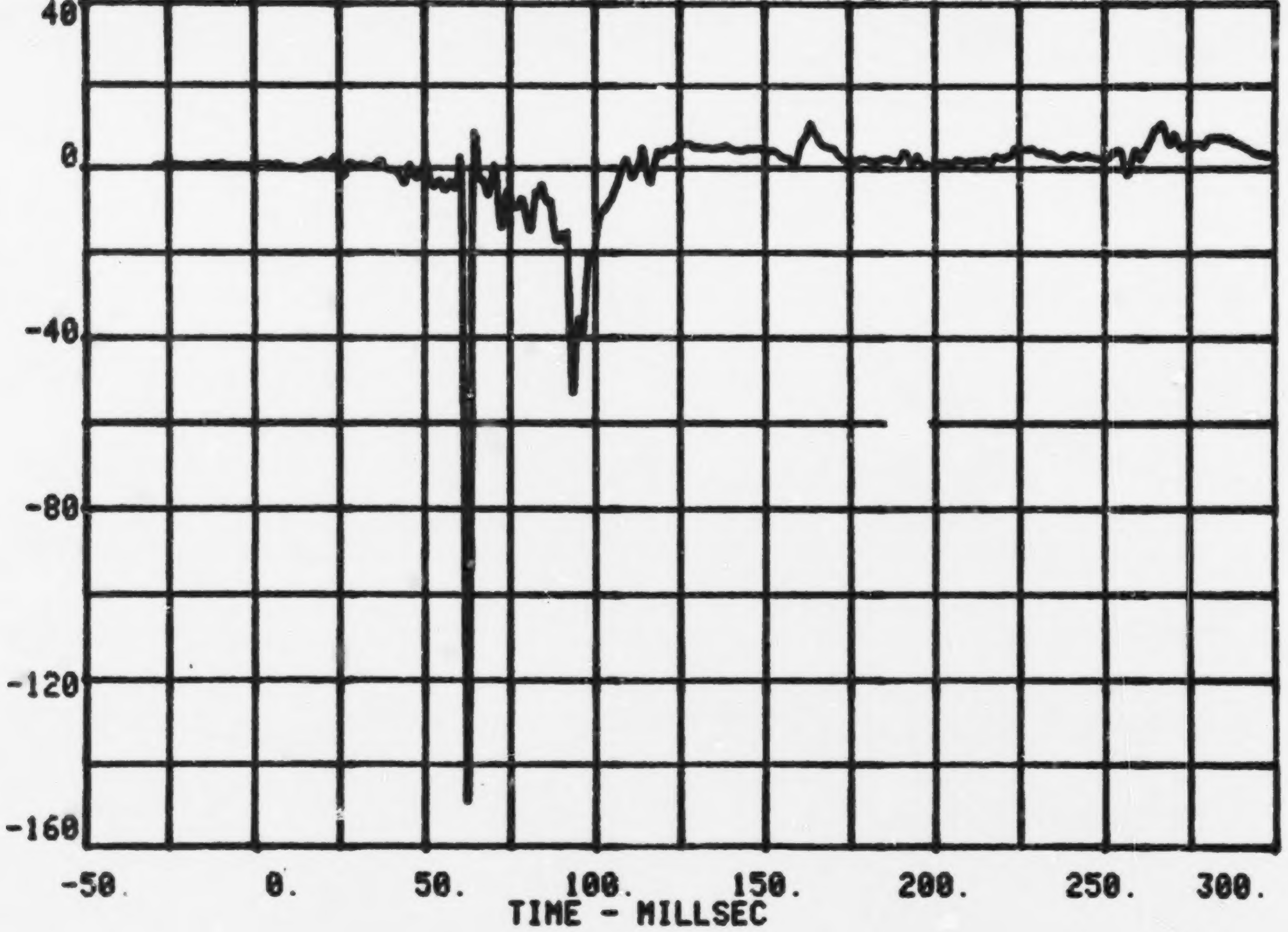

RUN= 2050 SERIES= 2050
CHANNEL 16 PELVIS ACCEL. Z
G'S
20
10
0
-10
-20
-30
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



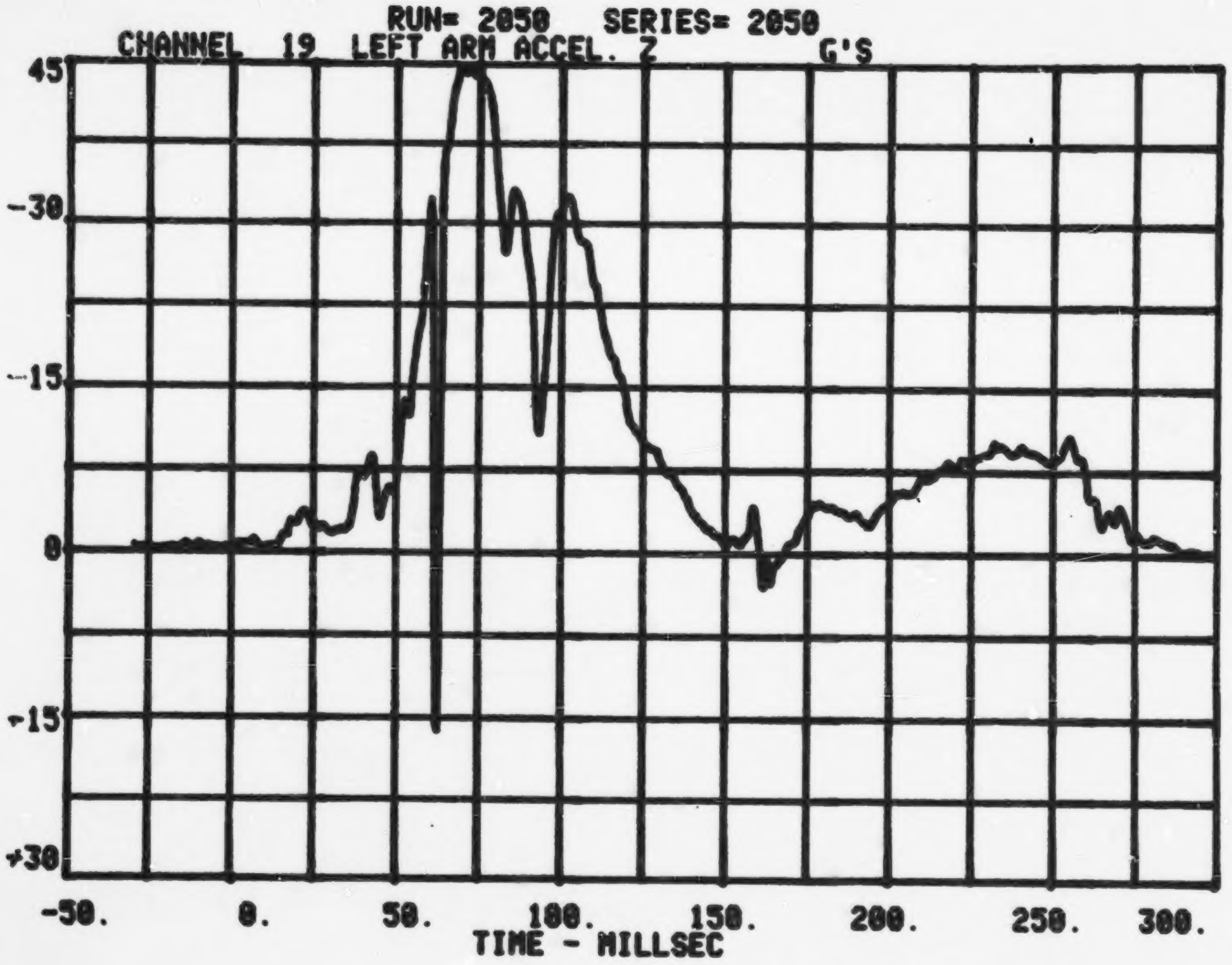
BEST DOCUMENT AVAILABLE

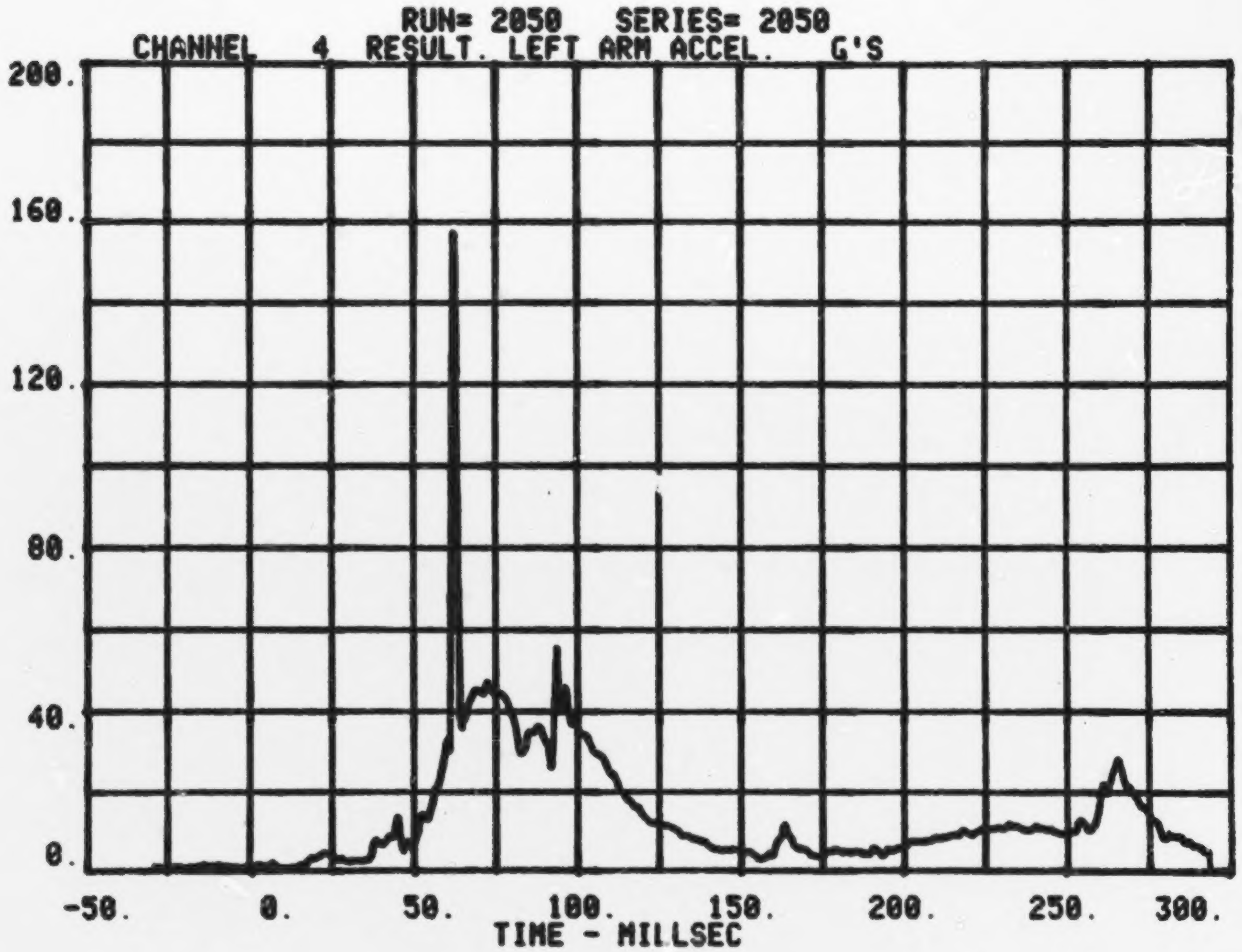

RUN= 2050 SERIES= 2050
CHANNEL 17 LEFT ARM ACCEL. X G'S
40
20
0
-20
-40
-60
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

RUN= 2050 SERIES= 2050
CHANNEL 18 LEFT ARM ACCEL. Y G'S



BEST DOCUMENT AVAILABLE


RUN= 2050 SERIES= 2050
CHANNEL 19 LEFT ARM ACCEL. Z G'S
45
-30
-15
0
+15
+30
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC



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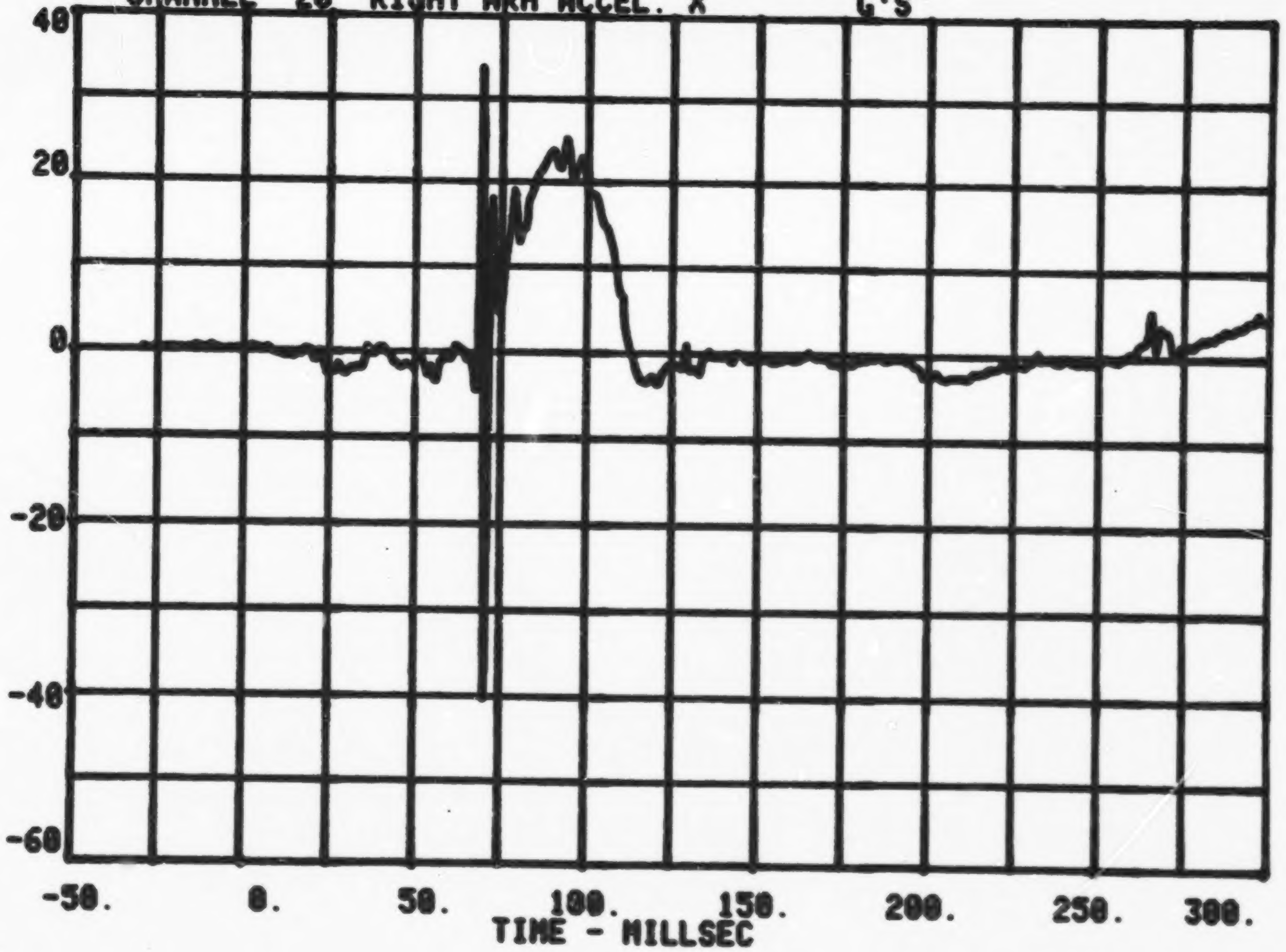
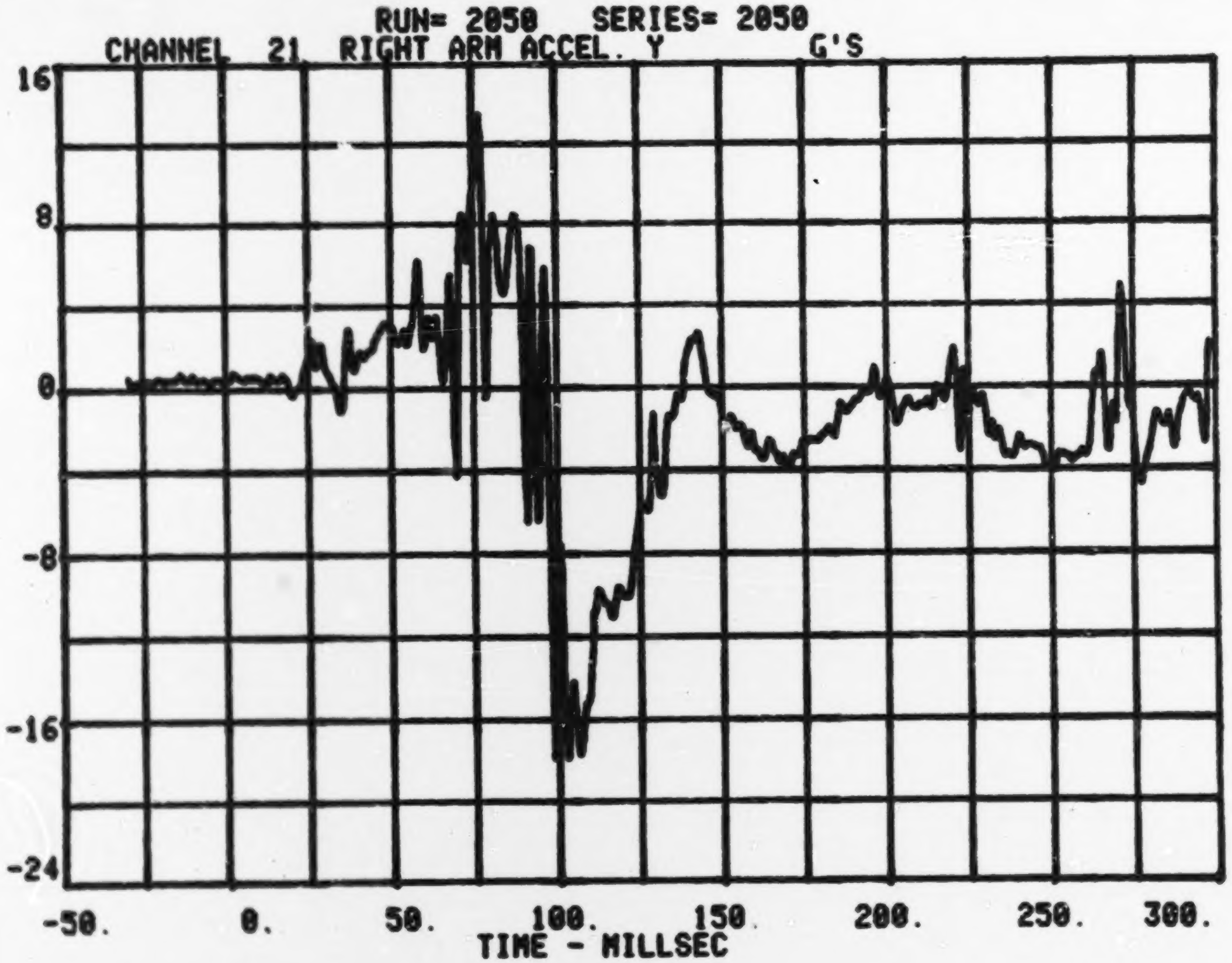
BEST DOCUMENT AVAILABLE


RUN= 2050 SERIES= 2050

CHANNEL 20 RIGHT ARM ACCEL. X G'S



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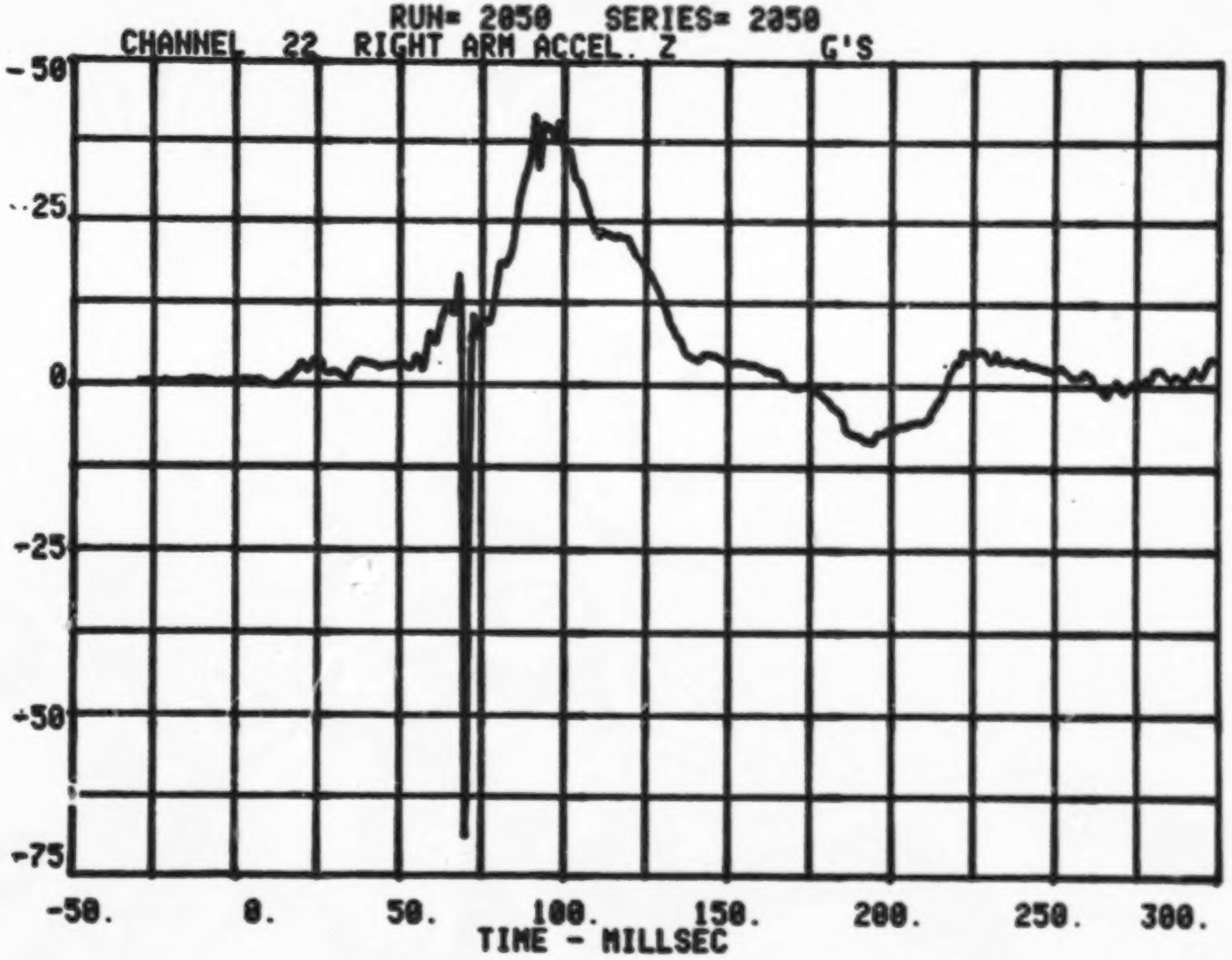
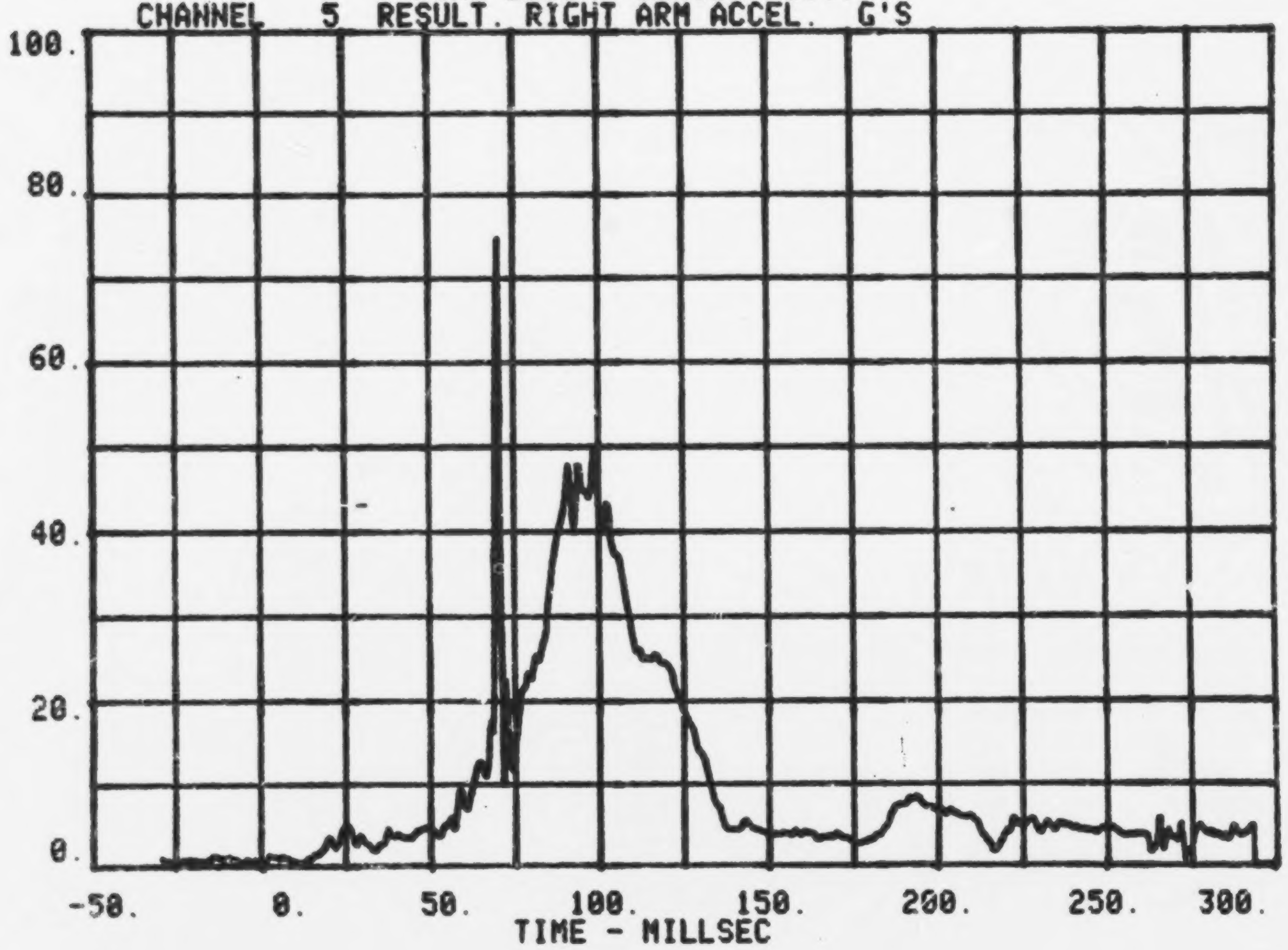
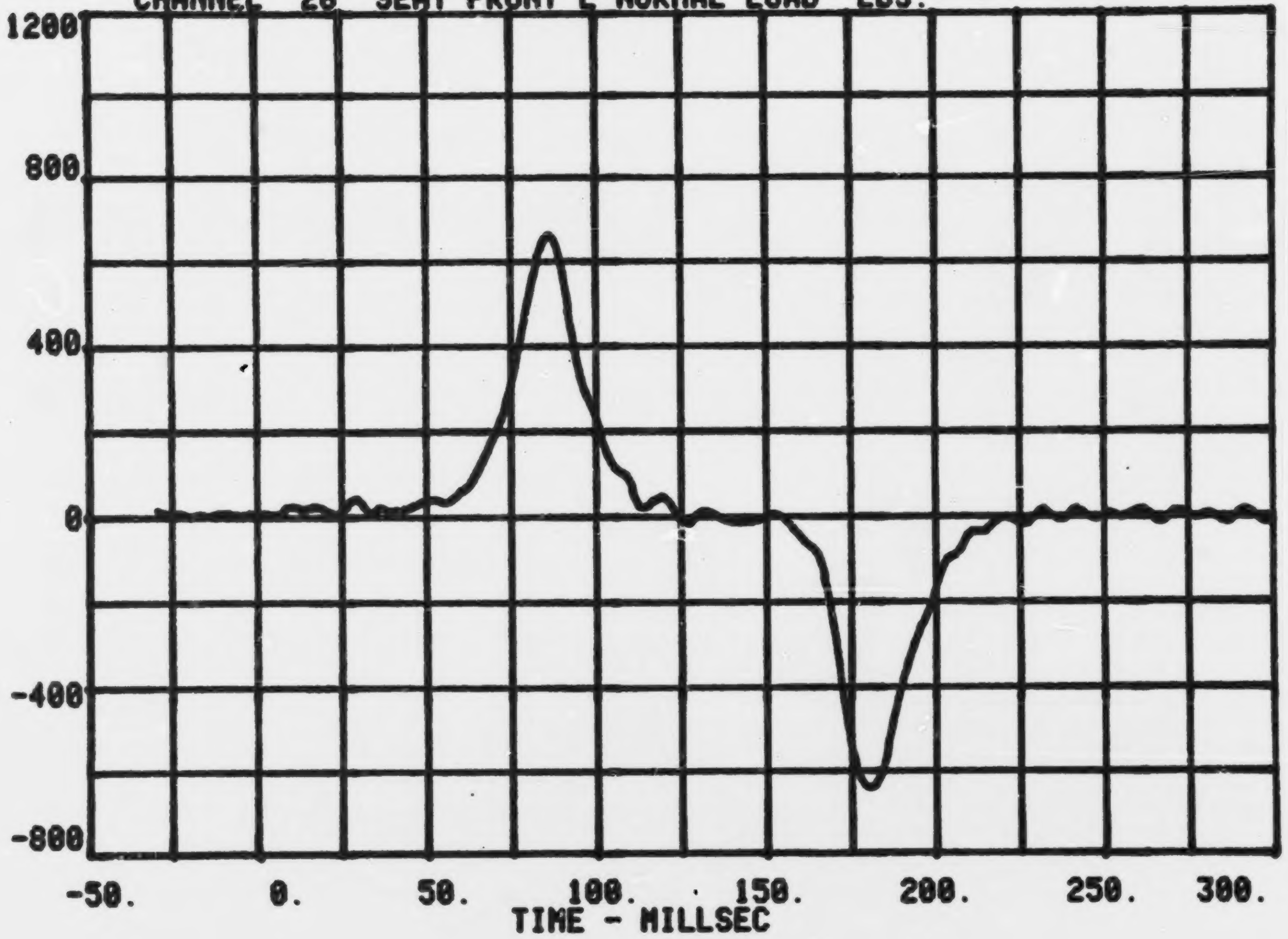


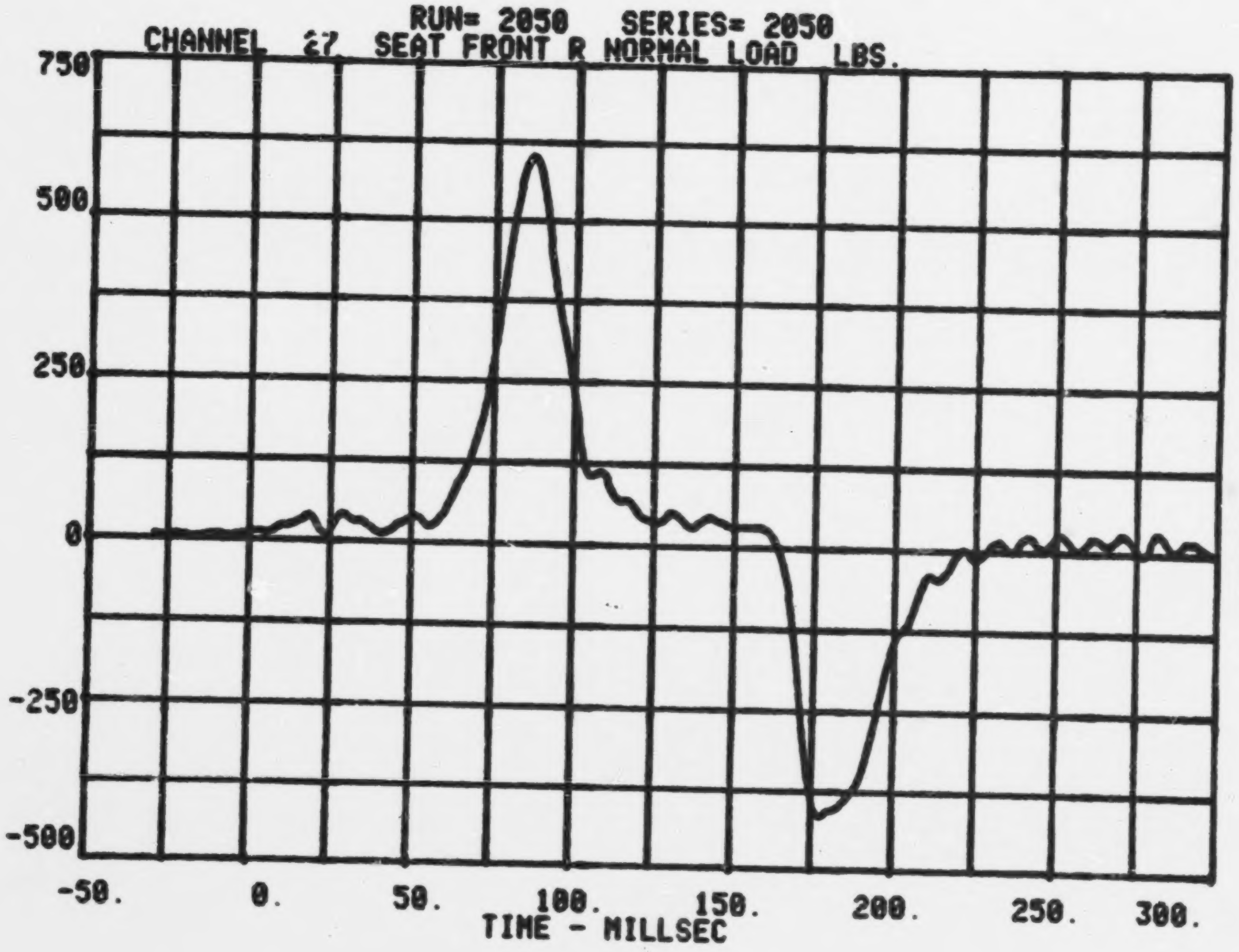
RUN= 2050 SERIES= 2050

CHANNEL 22 RIGHT ARM ACCEL. Z G'S


RUN= 2050 SERIES= 2050
CHANNEL 5 RESULT. RIGHT ARM ACCEL. G'S

RUN= 2050 SERIES= 2050
CHANNEL 26 SEAT FRONT L NORMAL LOAD LBS.



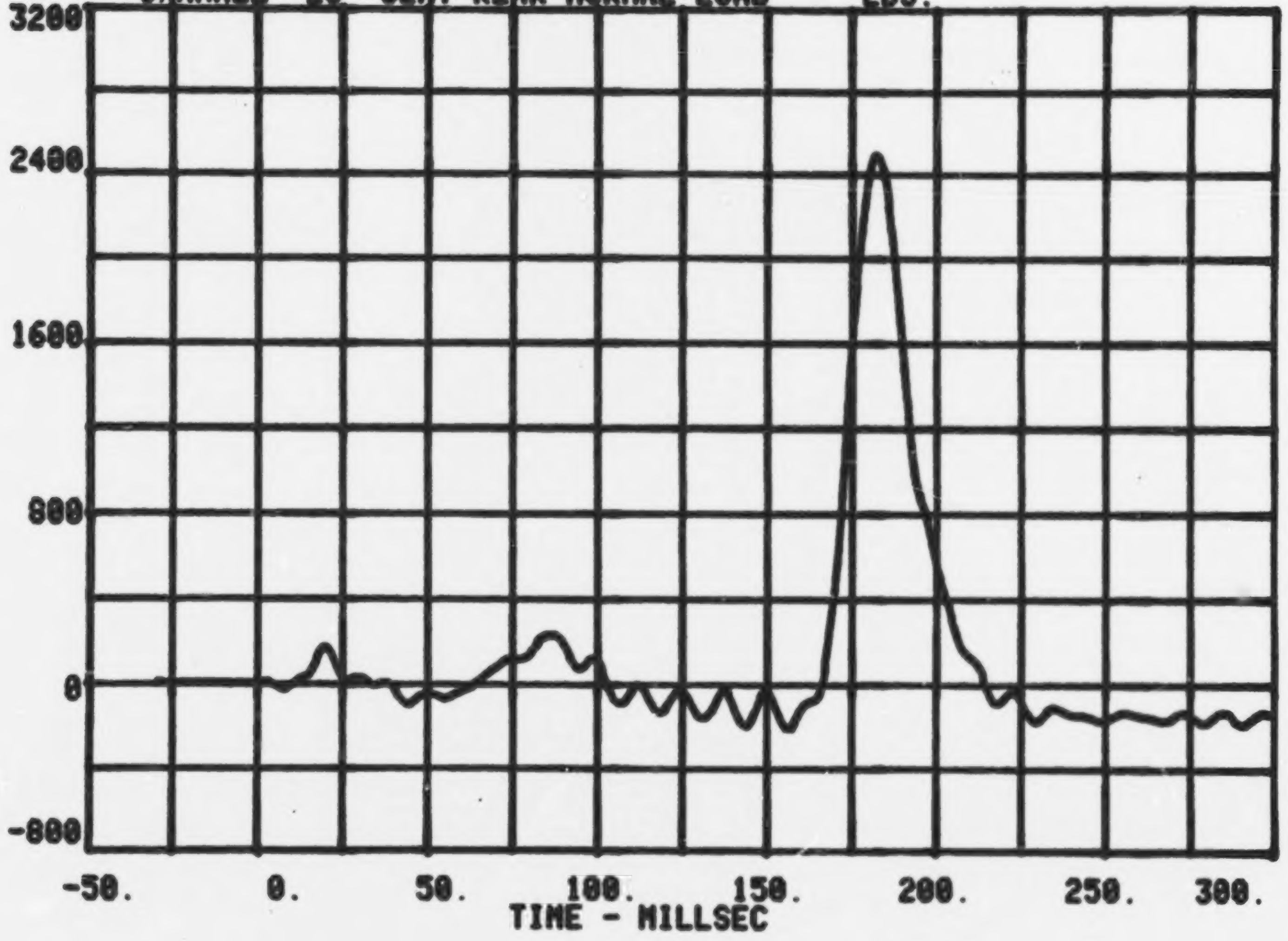


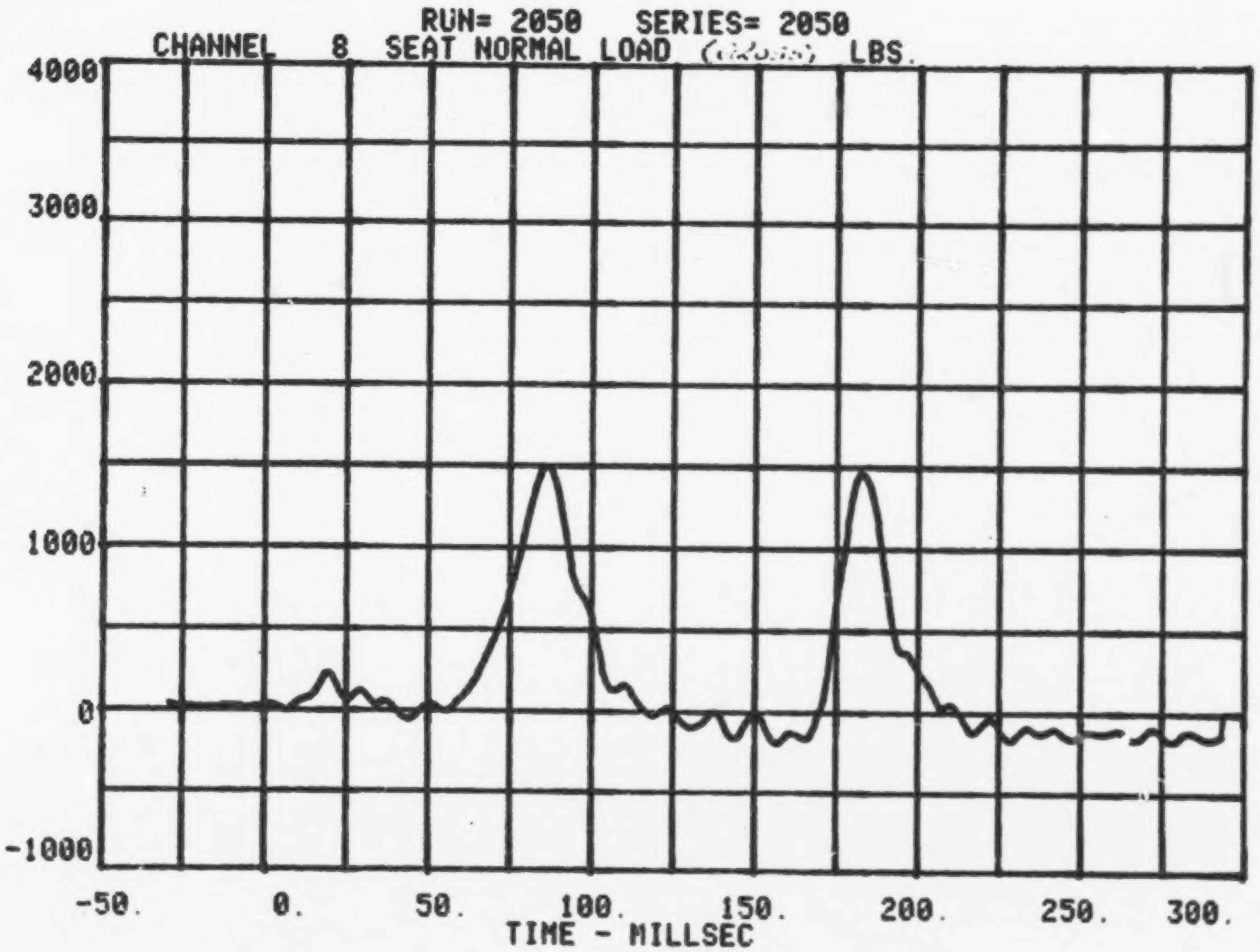
BEST DOCUMENT AVAILABLE

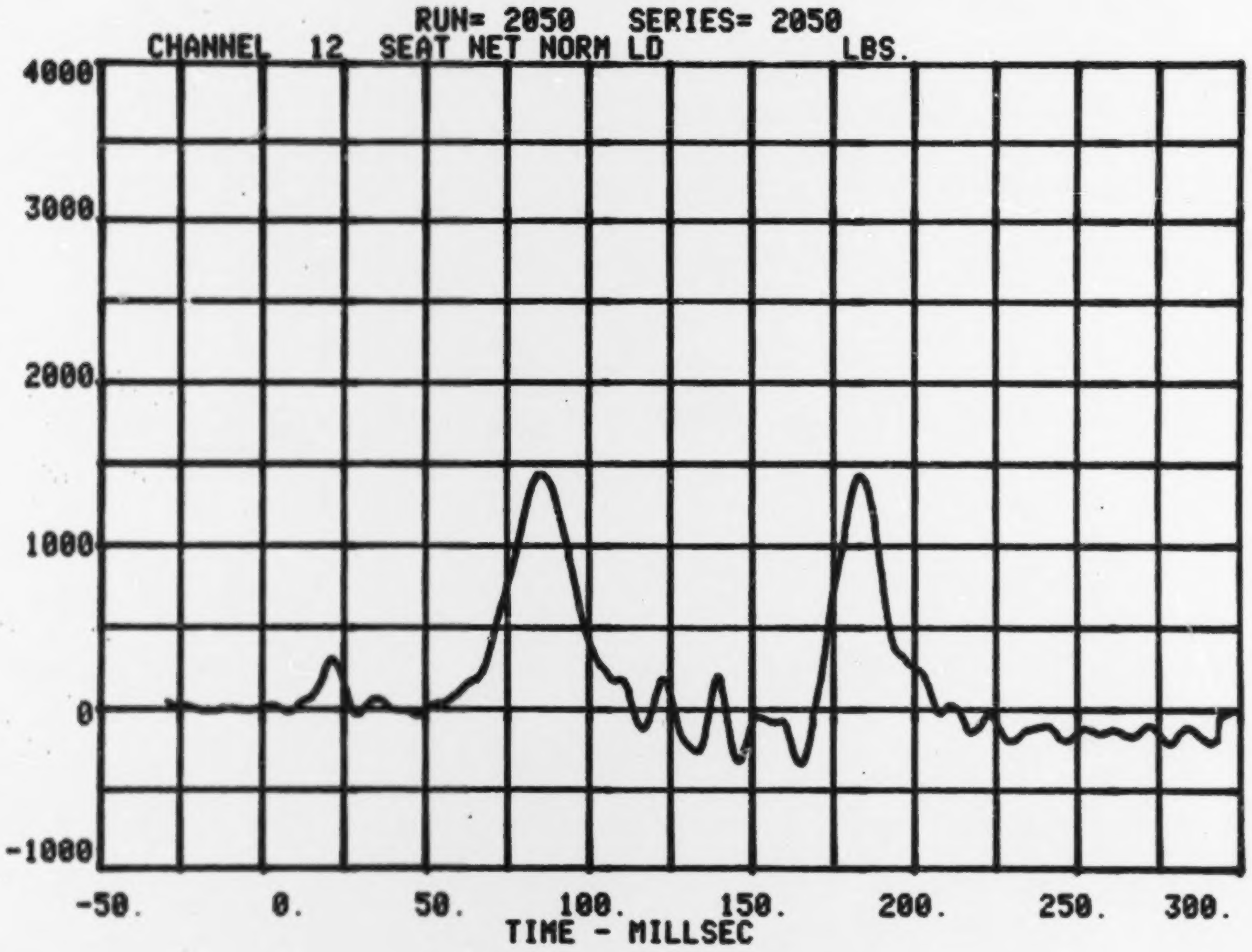
BEST DOCUMENT AVAILABLE

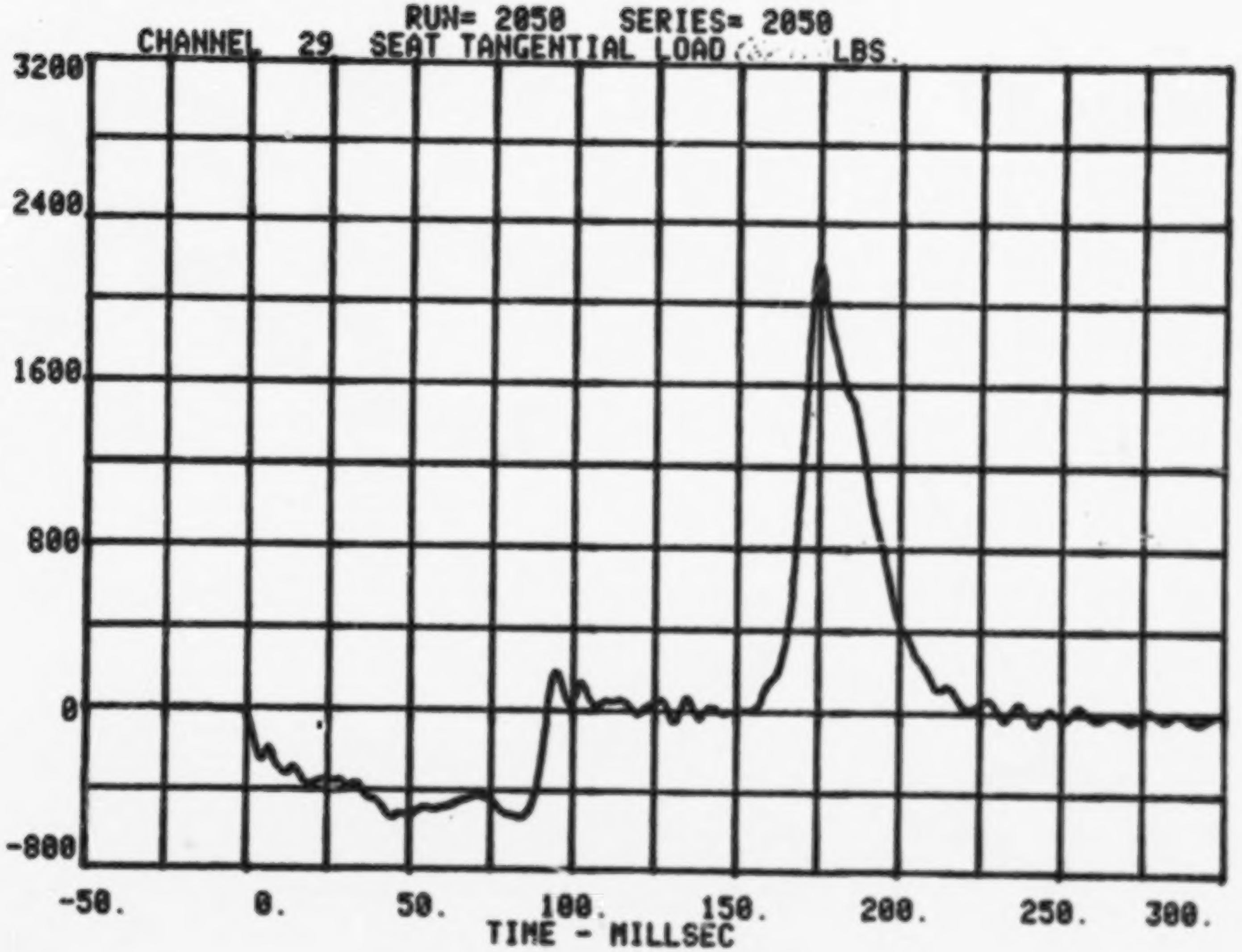
RUN= 2050 SERIES= 2050

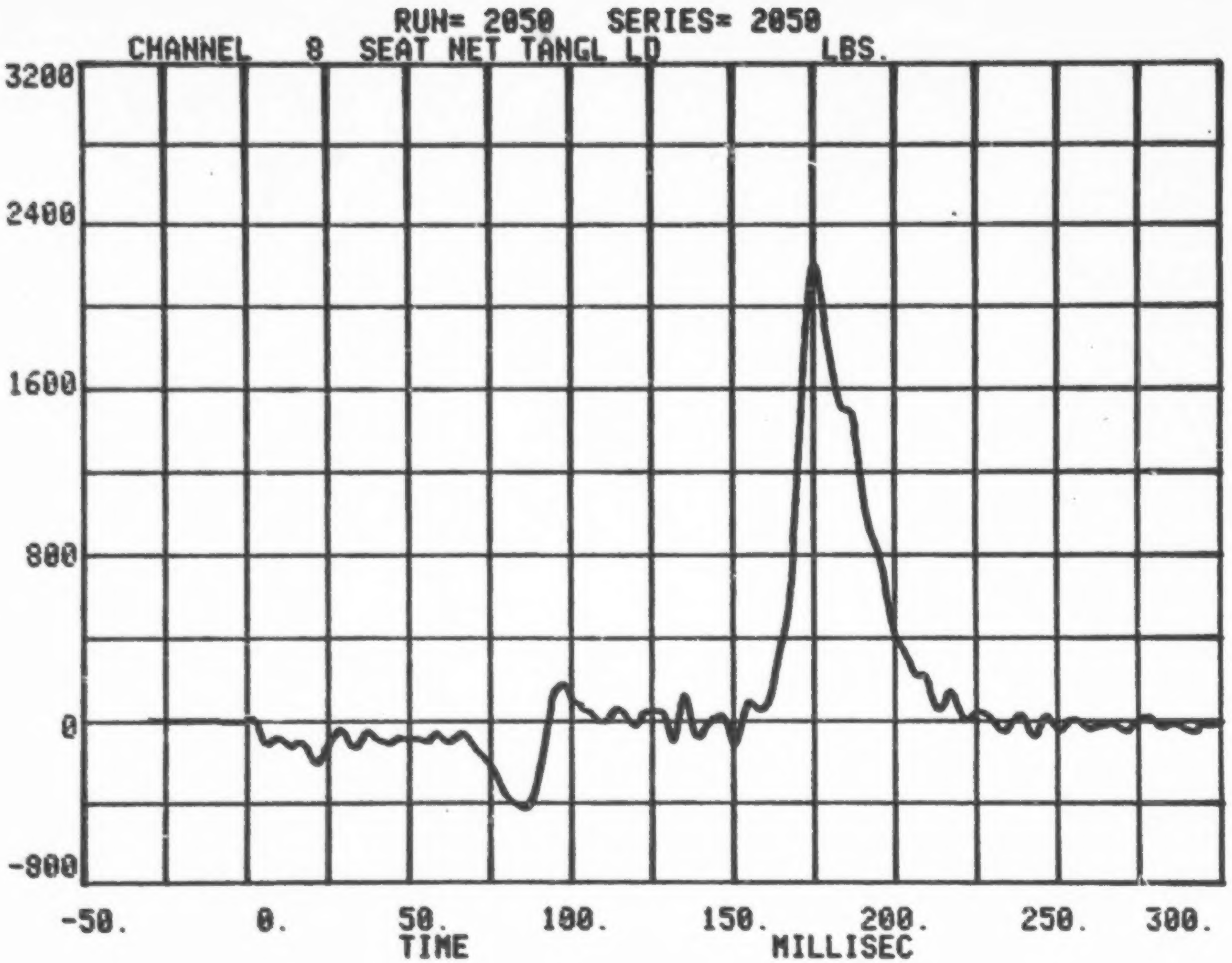
CHANNEL 28 SEAT REAR NORMAL LOAD LBS.




RUN= 2050 SERIES= 2050
CHANNEL 8 SEAT NORMAL LOAD LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

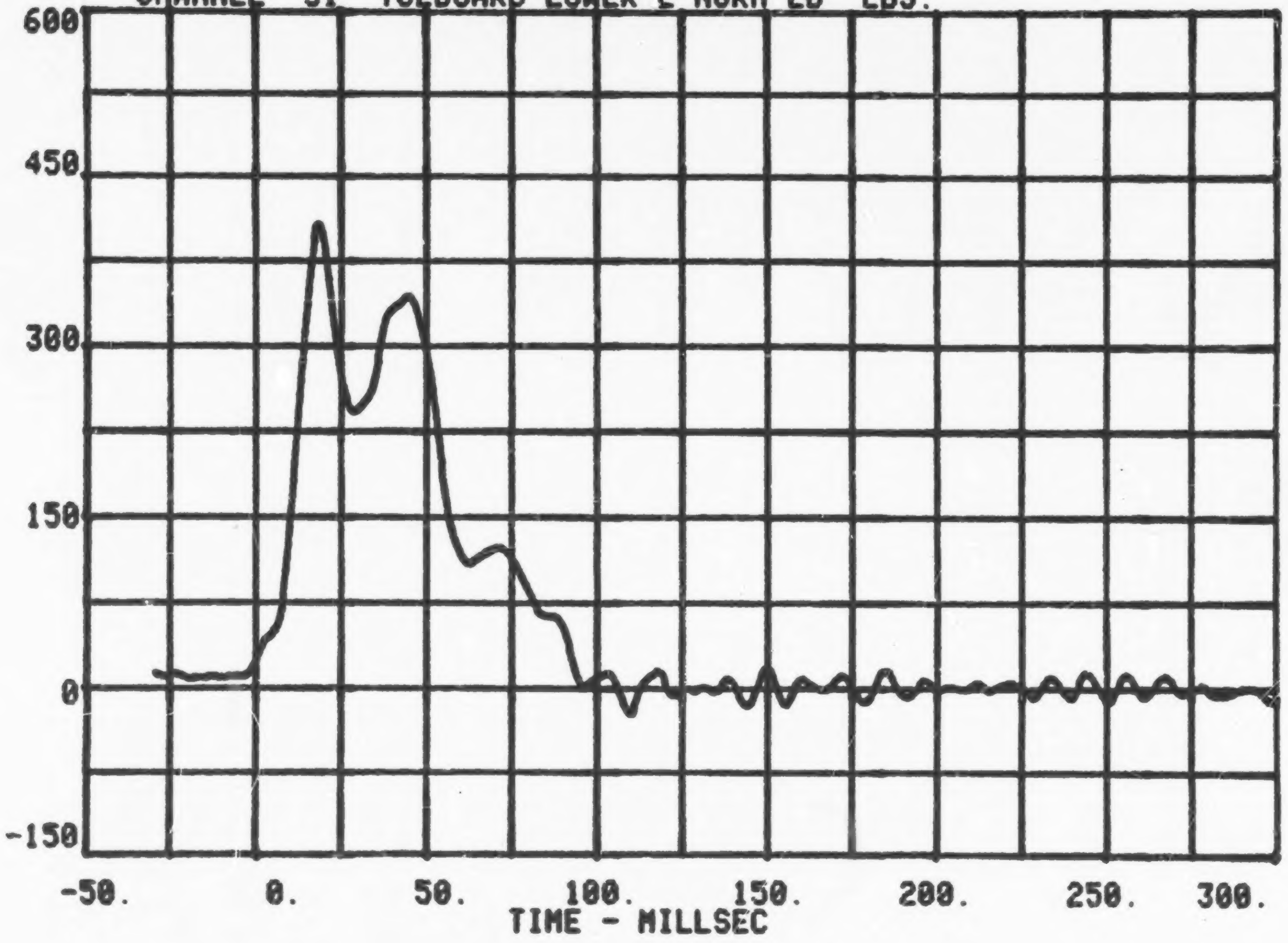

RUN= 2050 SERIES= 2050
CHANNEL 12 SEAT NET NORM LD LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 29 SEAT TANGENTIAL LOAD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 8 SEAT NET TANGL LD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

RUN= 2050 SERIES= 2050

CHANNEL 31 TOEBOARD LOWER L NORM LD LBS.



BEST DOCUMENT AVAILABLE

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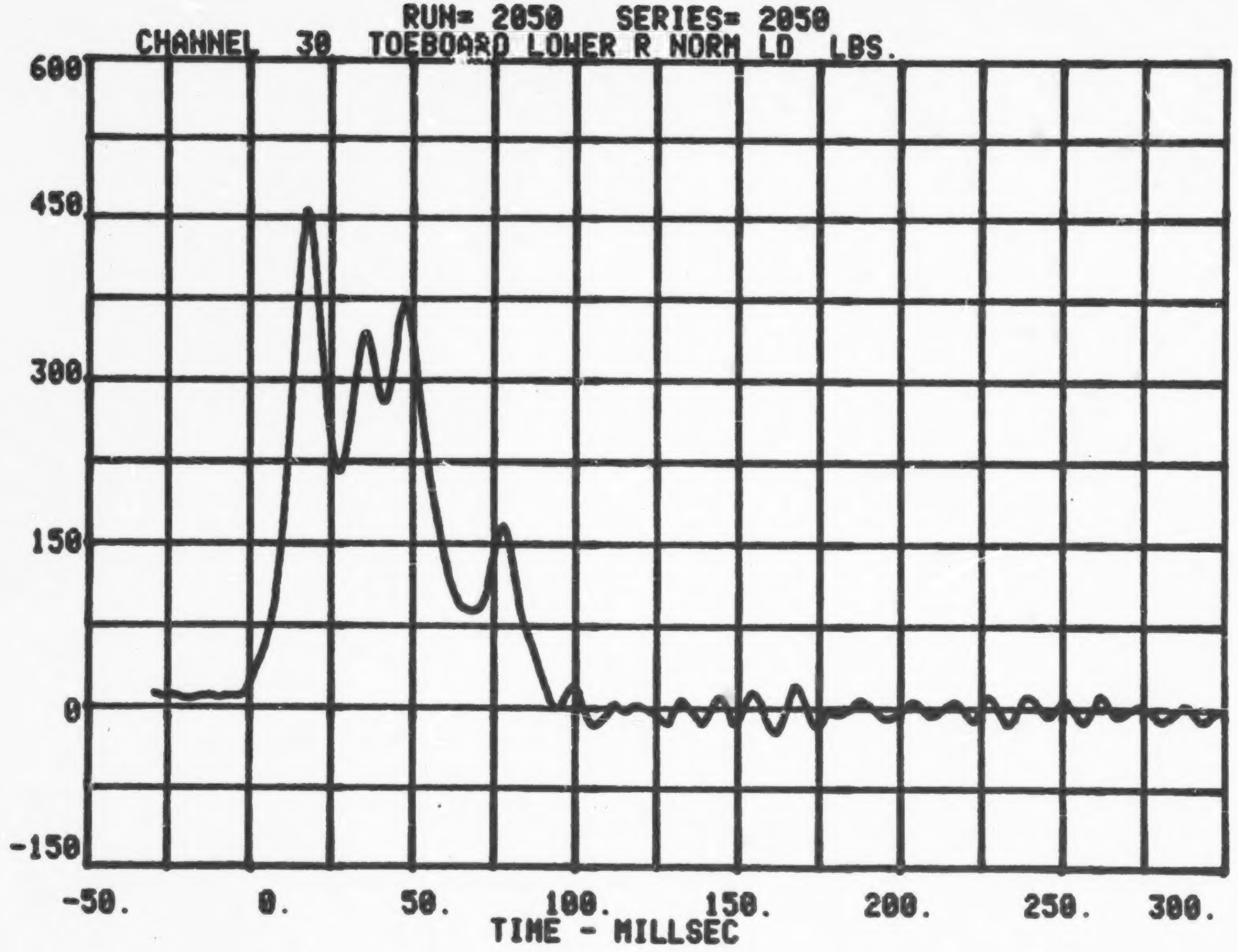
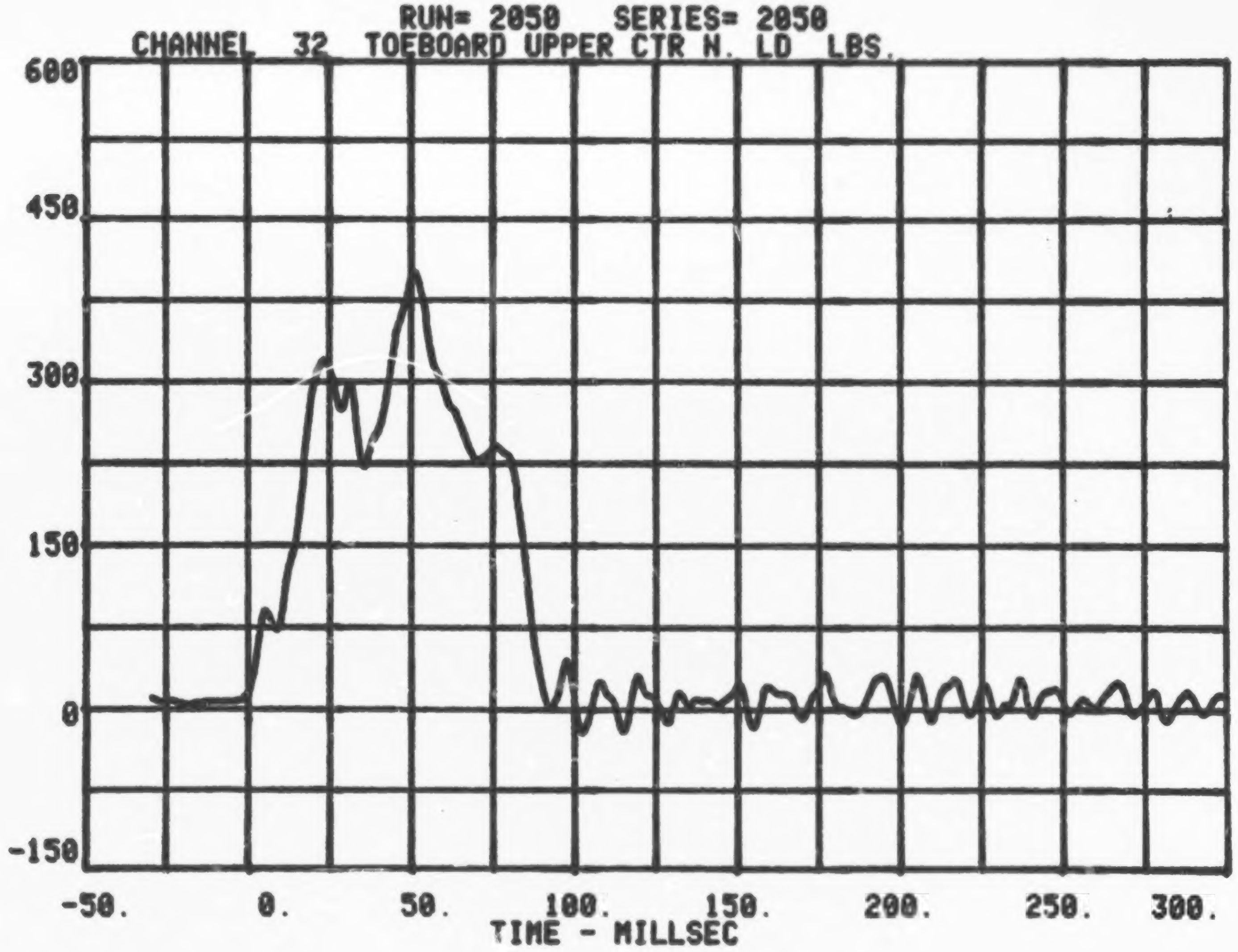
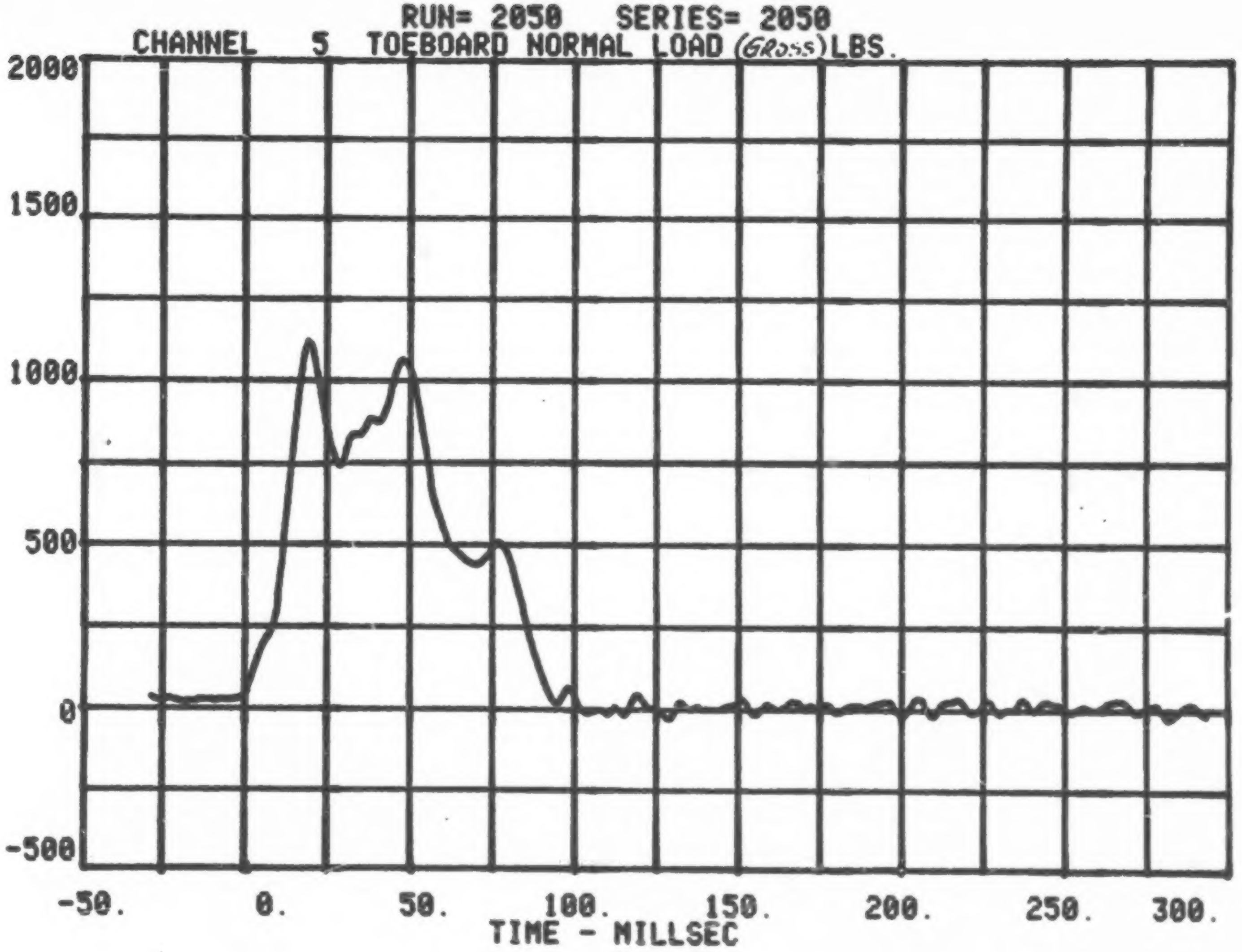
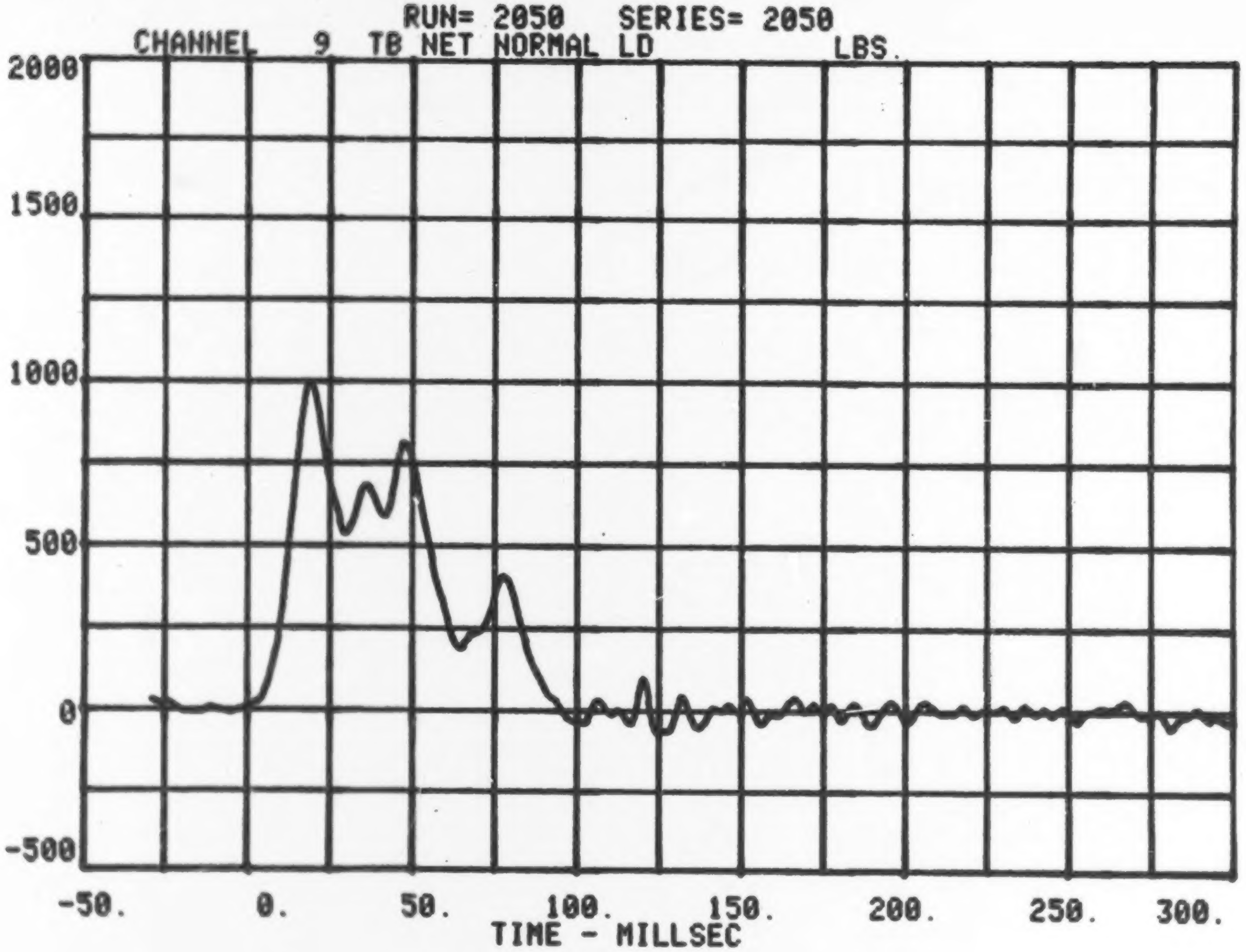

RUN= 2050 SERIES= 2050
CHANNEL 30 TOEBOARD LOWER R NORM LD LBS.
600
450
300
150
0
-150
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

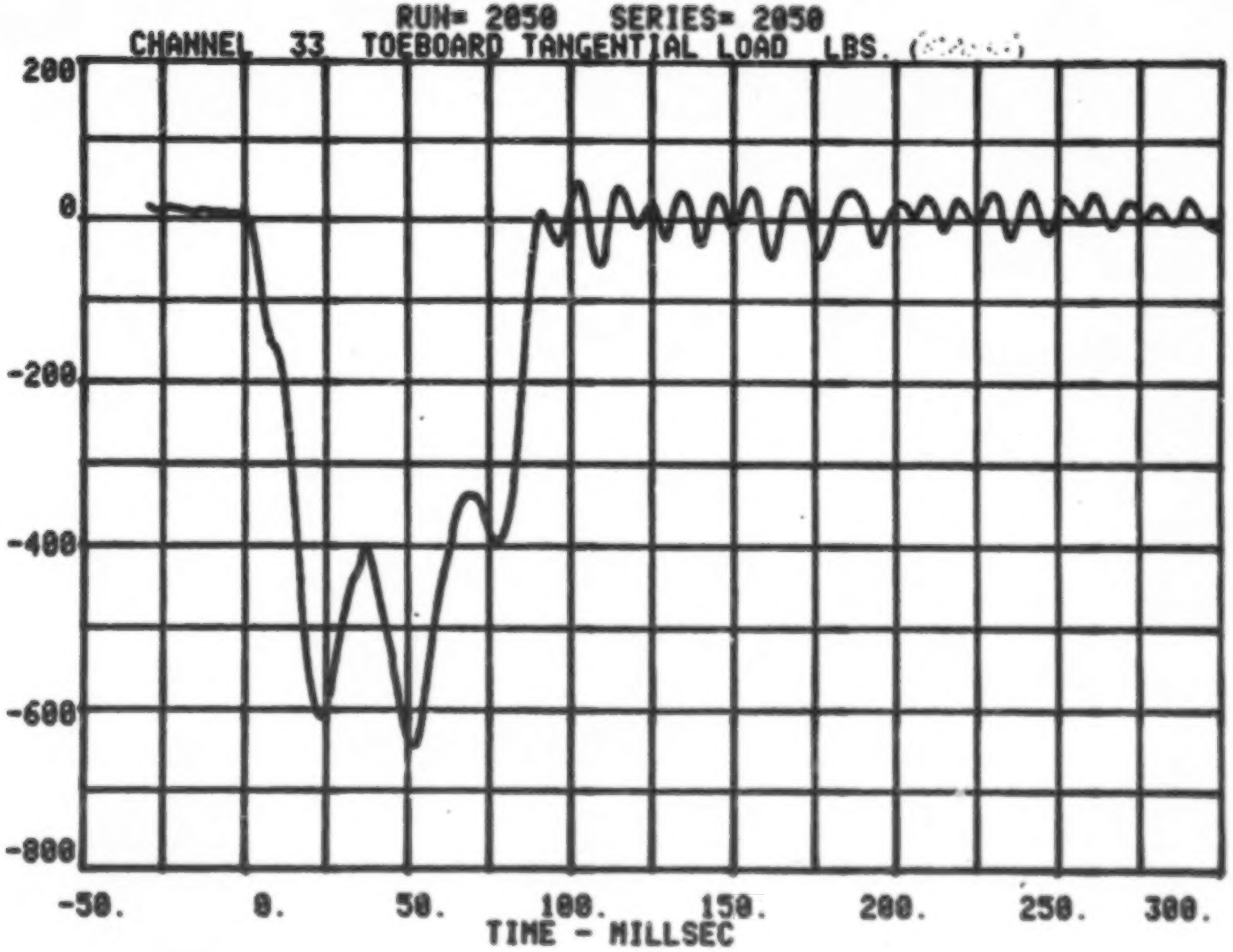


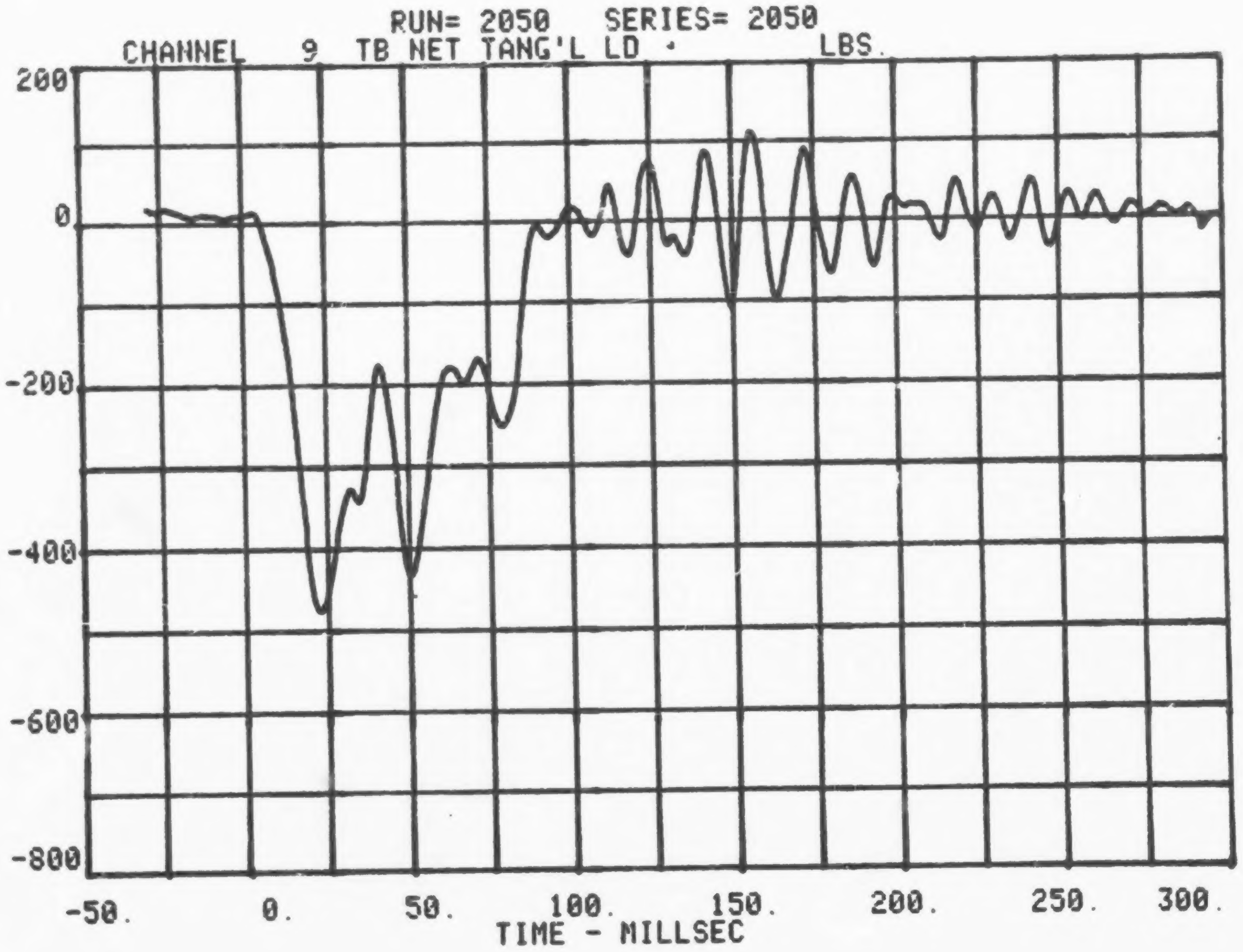
BEST DOCUMENT AVAILABLE

BEST DOCUMENT AVAILABLE

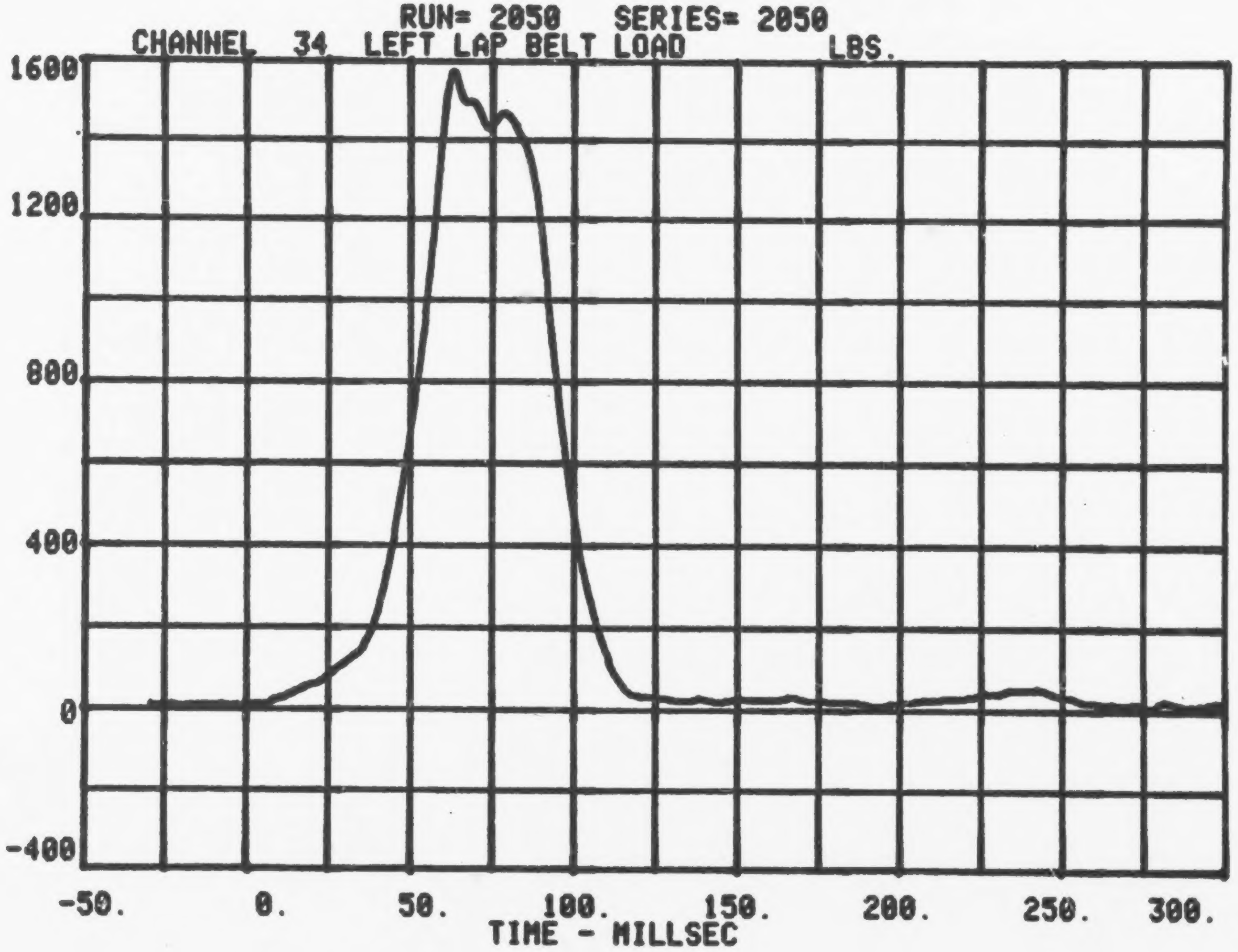

RUN= 2050 SERIES= 2050
CHANNEL 5 TOEBOARD NORMAL LOAD (GROSS) LBS.

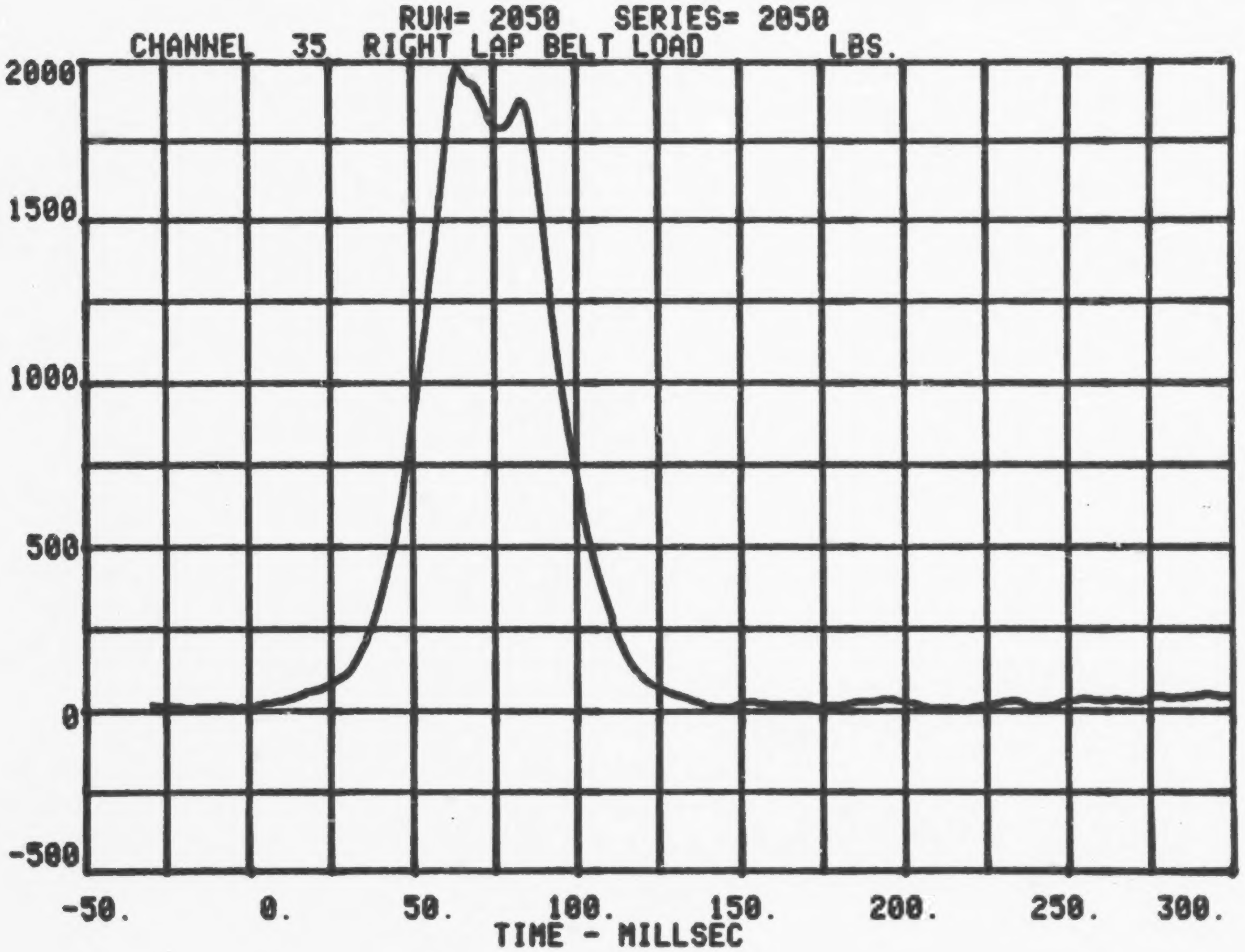

RUN= 2050 SERIES= 2050
CHANNEL 9 TB NET NORMAL LD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 33 TOEBOARD TANGENTIAL LOAD LBS.
200
0
-200
-400
-600
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 9 TB NET TANG'L LD · LBS.
200
0
-200
-400
-600
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE





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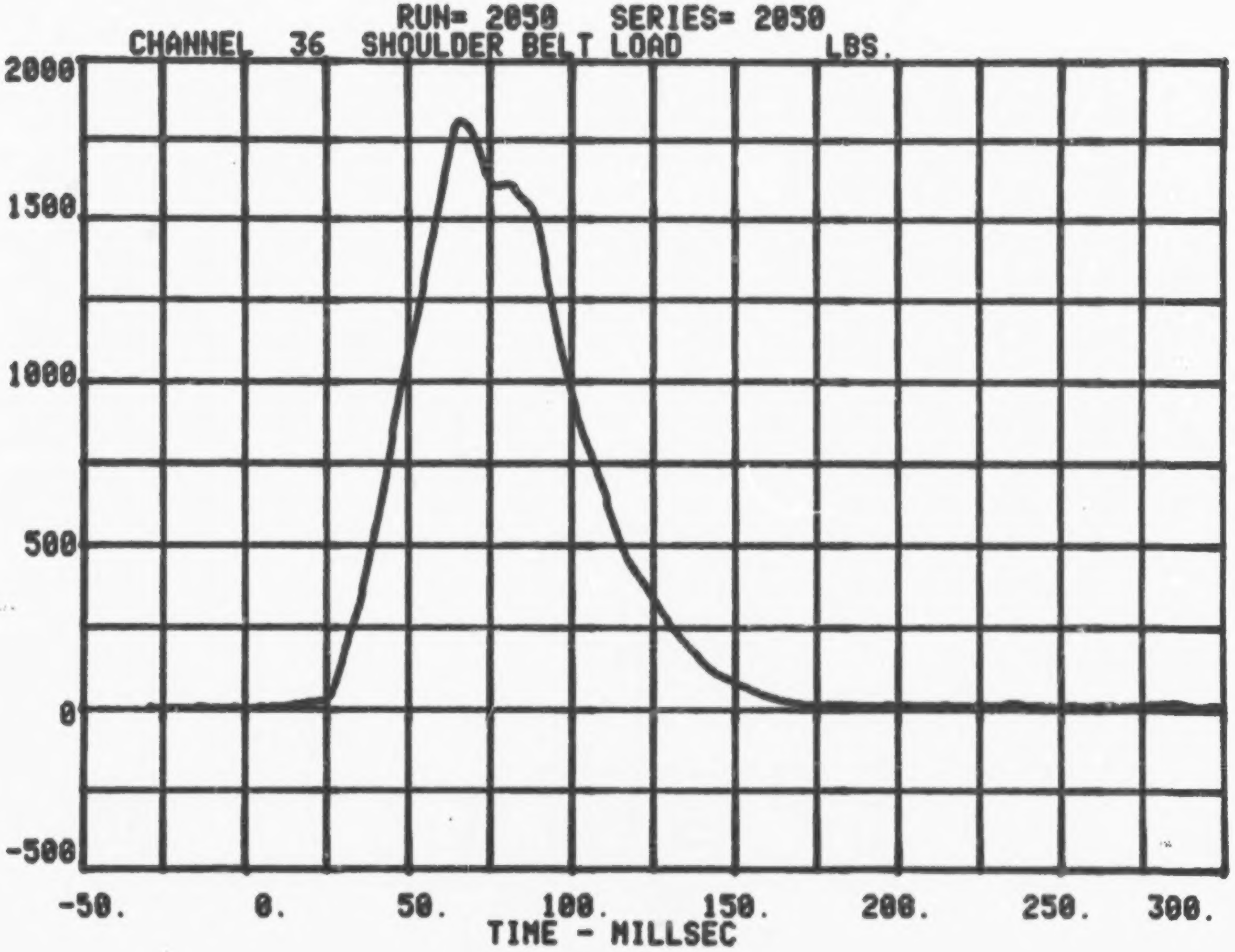
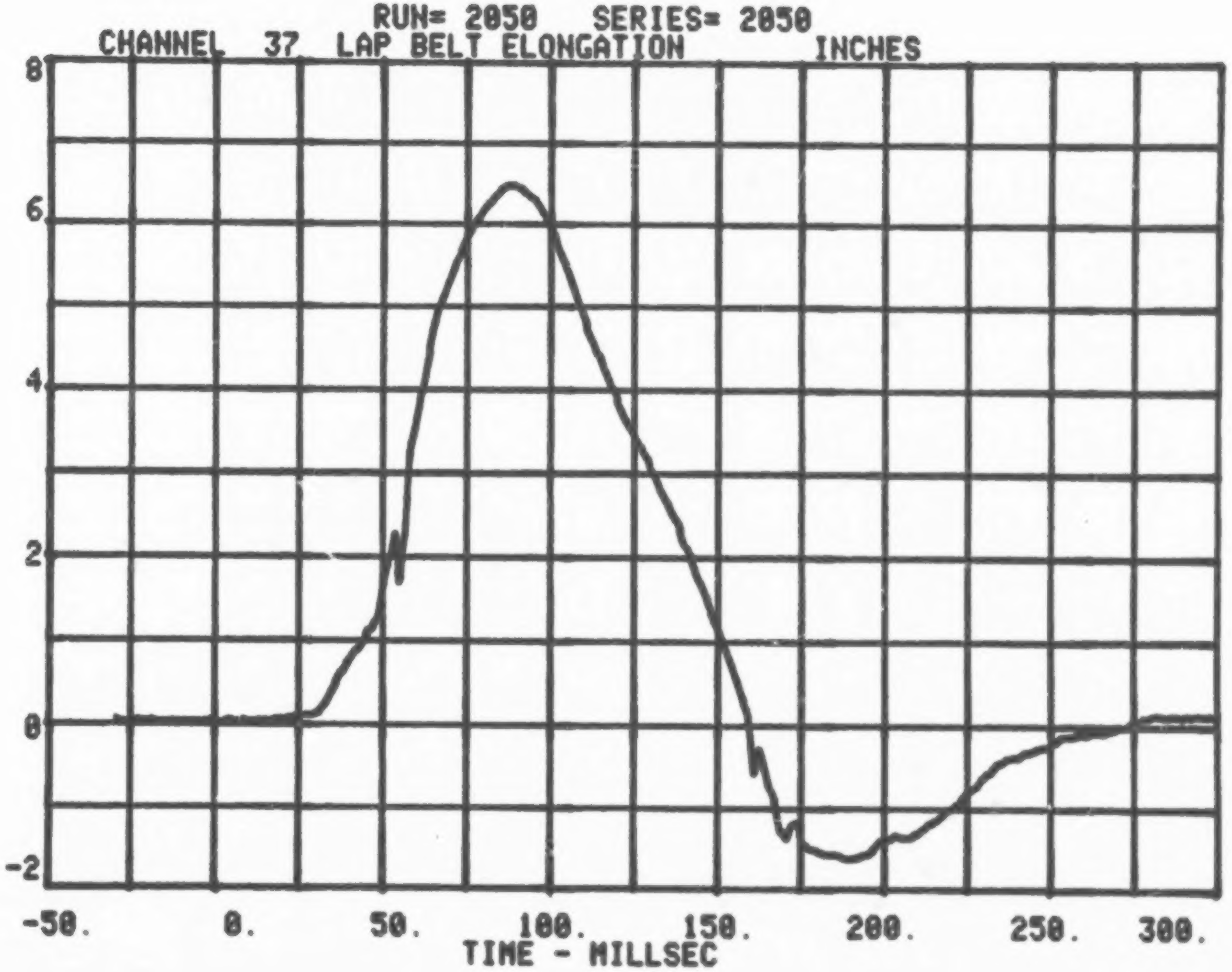
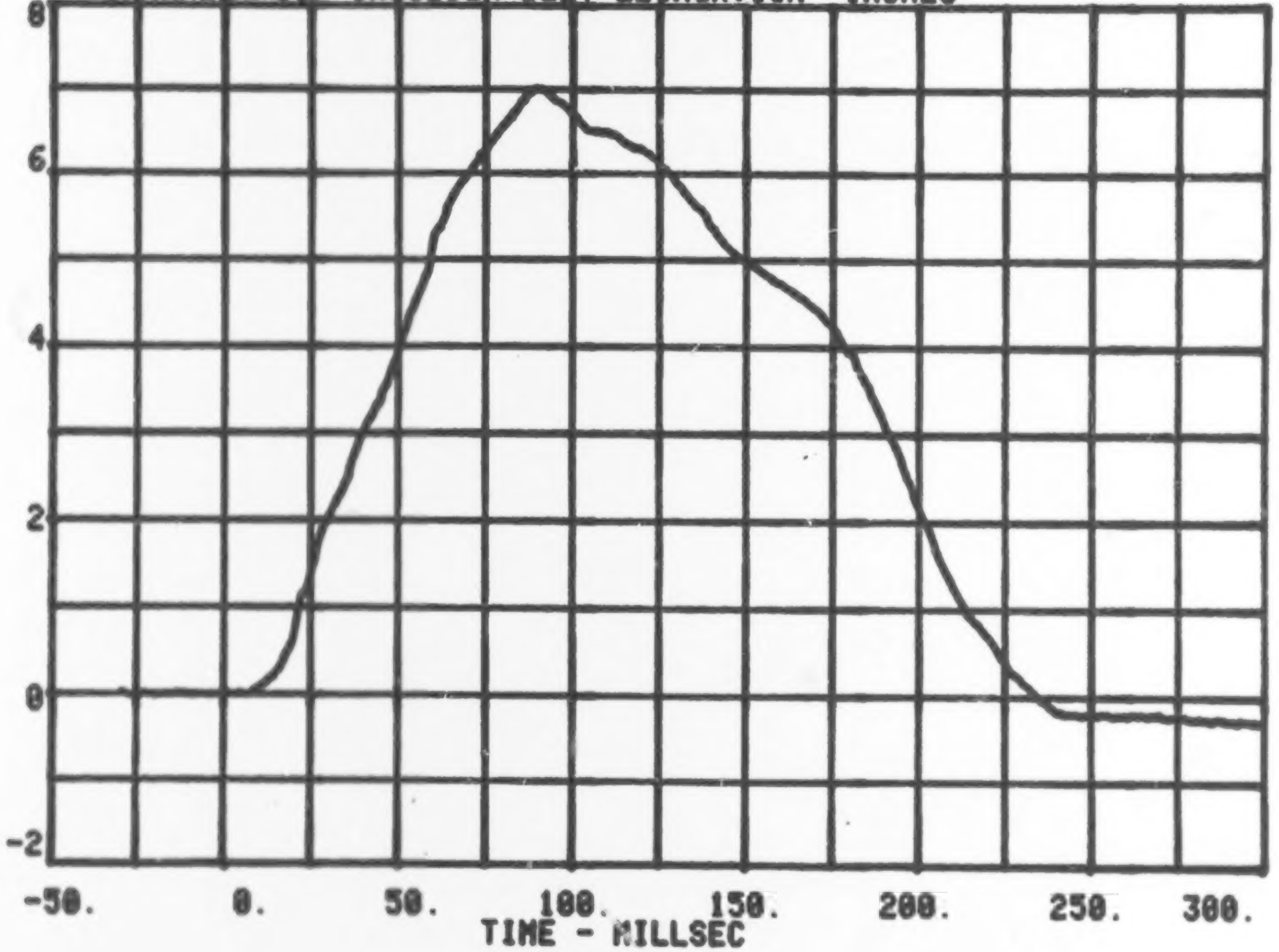

RUN= 2050 SERIES= 2050
CHANNEL 36 SHOULDER BELT LOAD LBS.

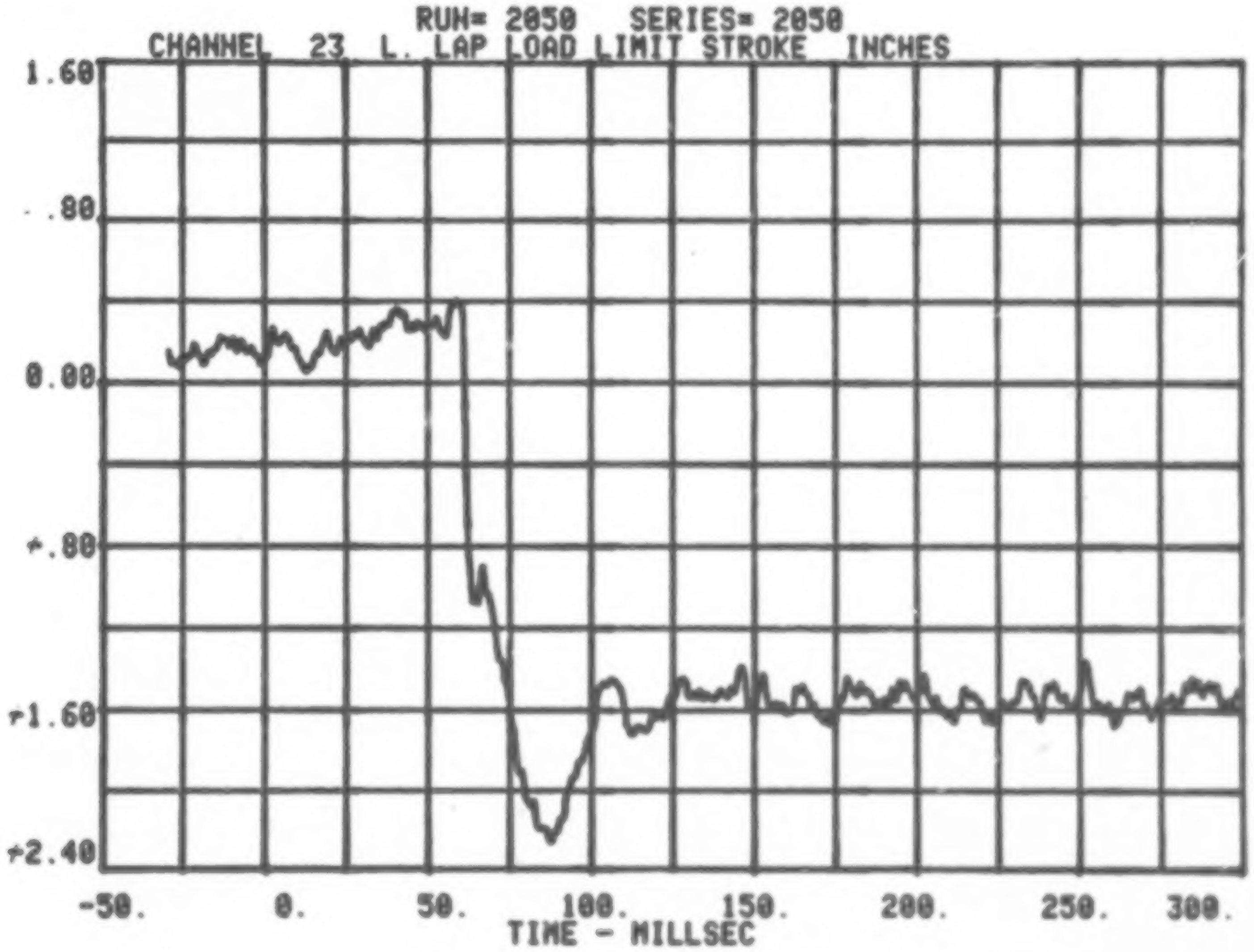

RUN= 2050 SERIES= 2050
CHANNEL 37 LAP BELT ELONGATION INCHES
8
6
4
2
0
-2
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

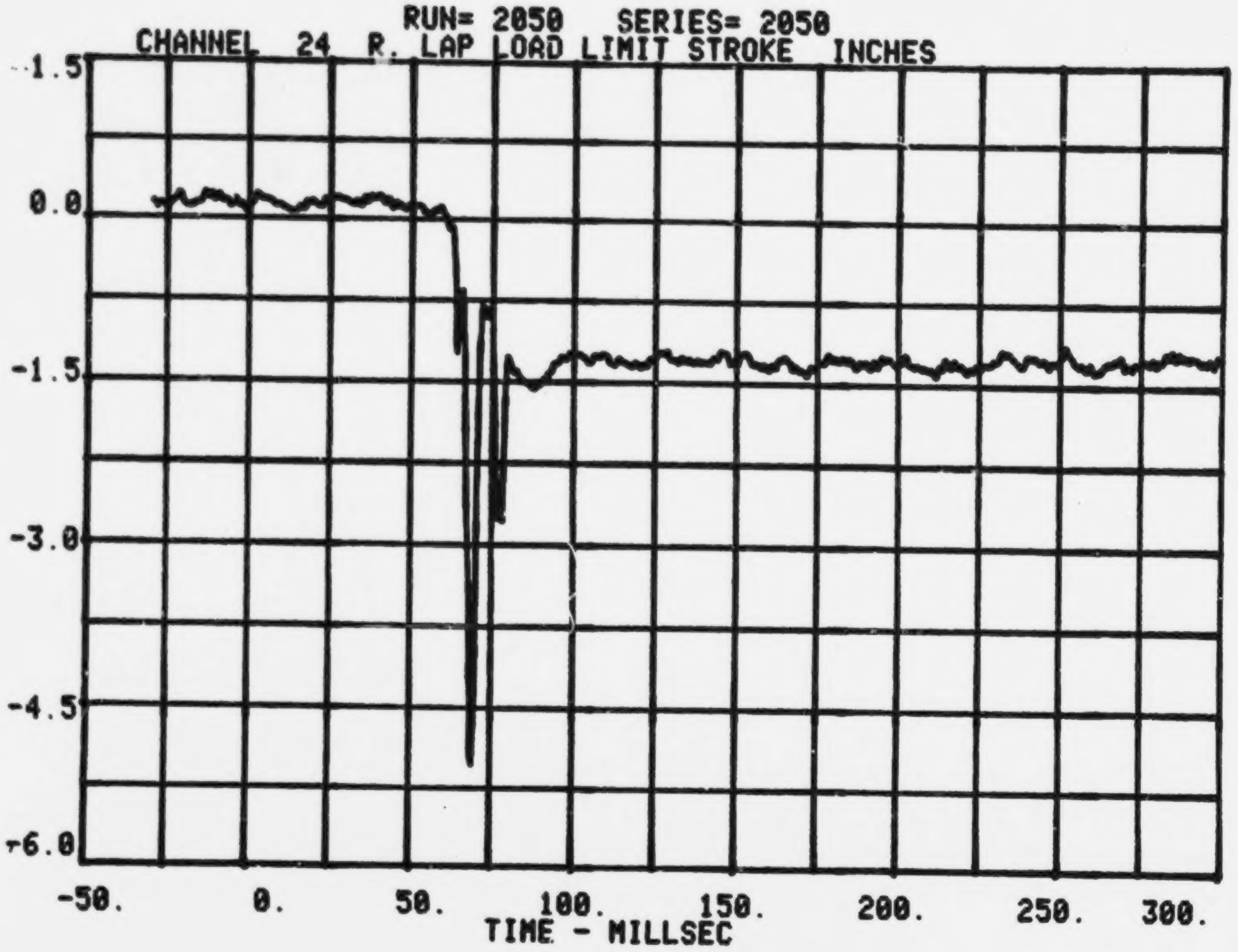
BEST DOCUMENT AVAILABLE

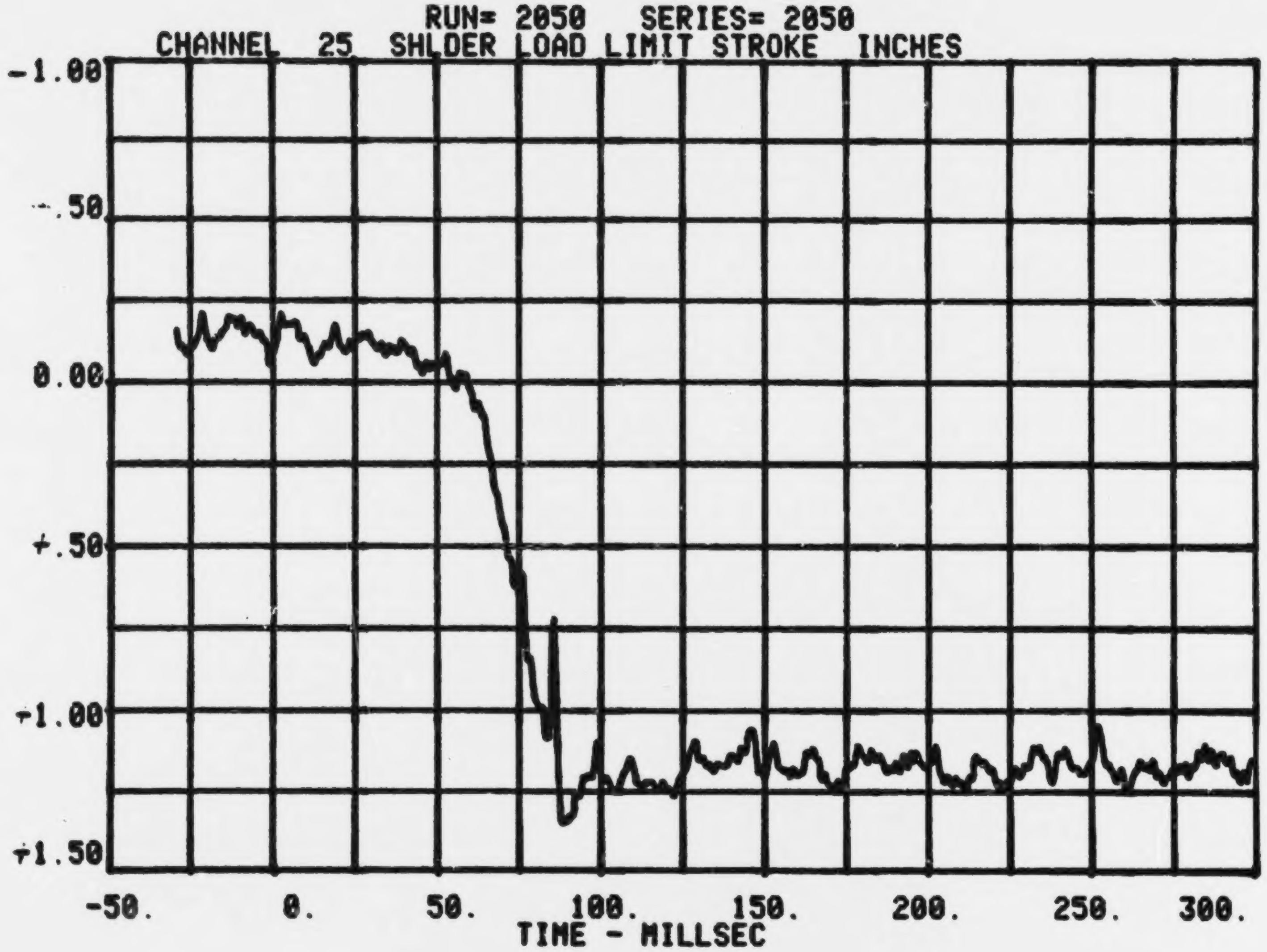
RUN= 2050 SERIES= 2050
CHANNEL 30 SHOULDER BELT ELONGATION INCHES



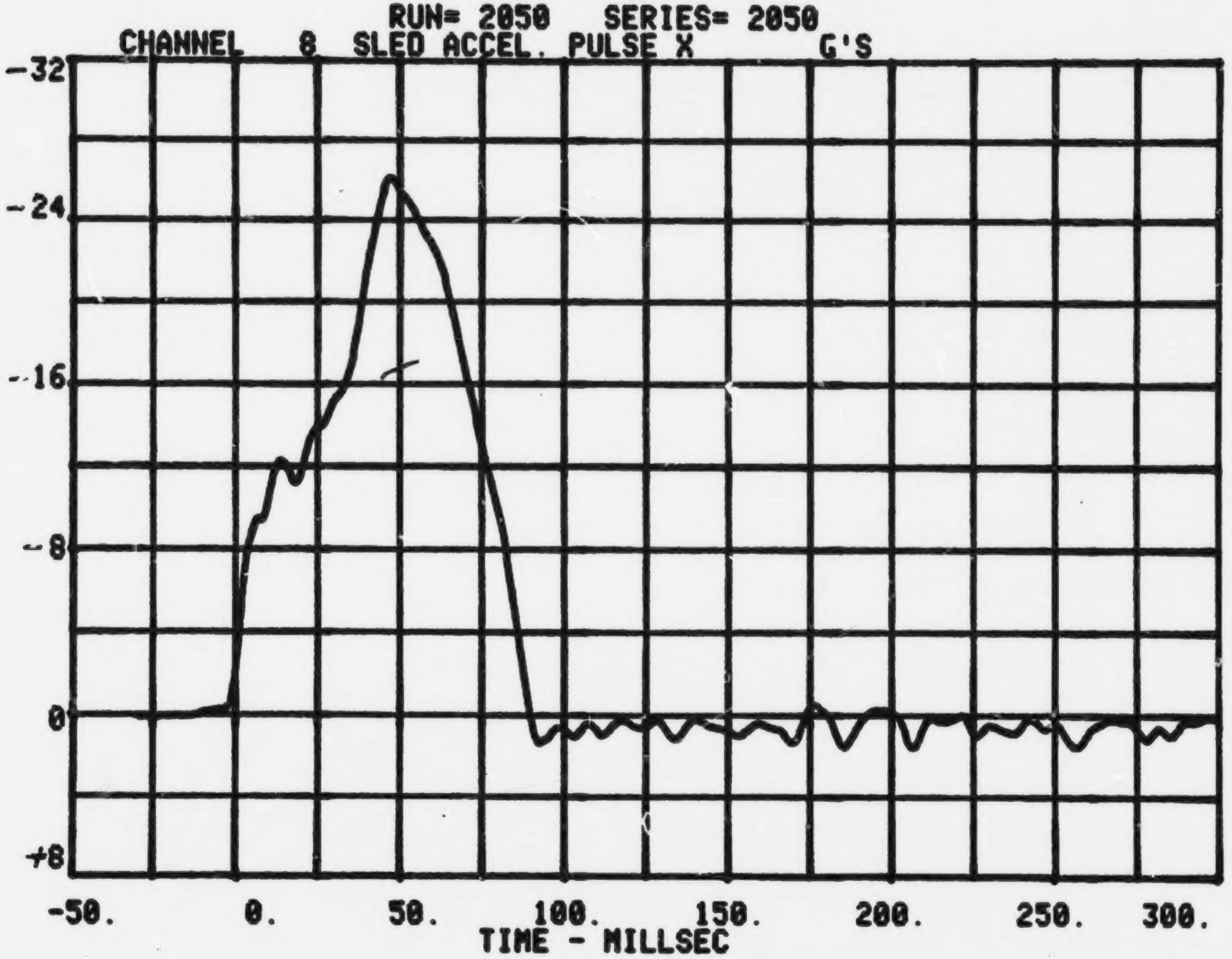
038


RUN= 2050 SERIES= 2050
CHANNEL 23 L. LAP LOAD LIMIT STROKE INCHES
1.60
.80
0.00
-.80
-1.60
-2.40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 24 R. LAP LOAD LIMIT STROKE INCHES
1.5
0.0
-1.5
-3.0
-4.5
-6.0
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2050 SERIES= 2050
CHANNEL 25 SHLDER LOAD LIMIT STROKE INCHES
-1.00
-.50
0.00
+.50
+1.00
+1.50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE


RUN= 2050 SERIES= 2050

CHANNEL 8 SLED ACCEL. PULSE X G'S

APPENDIX H

BELT RESTRAINT SLED TEST 2051 DATA RECORDS

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Pelvis Accelerations	180
Arm Accelerations	180
Femur Loads	600
Contact Panel Loads	60
Belt Loads	60
Belt Elongations	180
Load Limiter Strokes	180
Sled Acceleration	60

Sequence of Data Records

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Pelvis - X, Y, Z, Resultant Accelerations

Left Arm - X, Y, Z, Resultant Accelerations

Right Arm - X, Y, Z, Resultant Accelerations

Seat Normal Load - Front Left, Front Right, Rear, Gross Sum, Net Sum

Seat Tangential Load - Gross, Net

Toeboard Normal Load - Lower Left, Lower Right, Upper Center, Gross Sum, Net Sum

Toeboard Tangential Load - Gross, Net

Belt Load - Left Lap, Right Lap, Shoulder

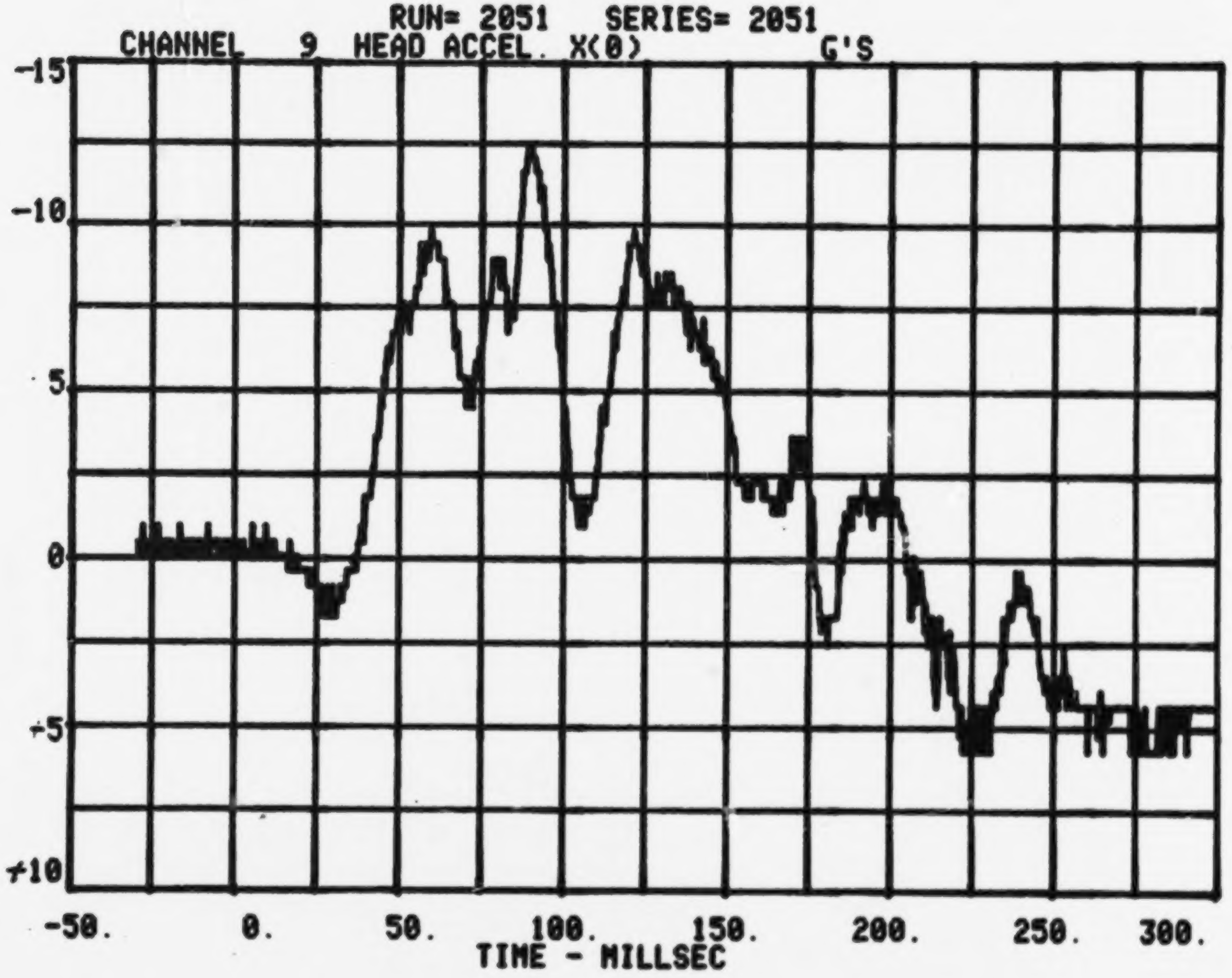
Belt Elongation - Lap, Shoulder

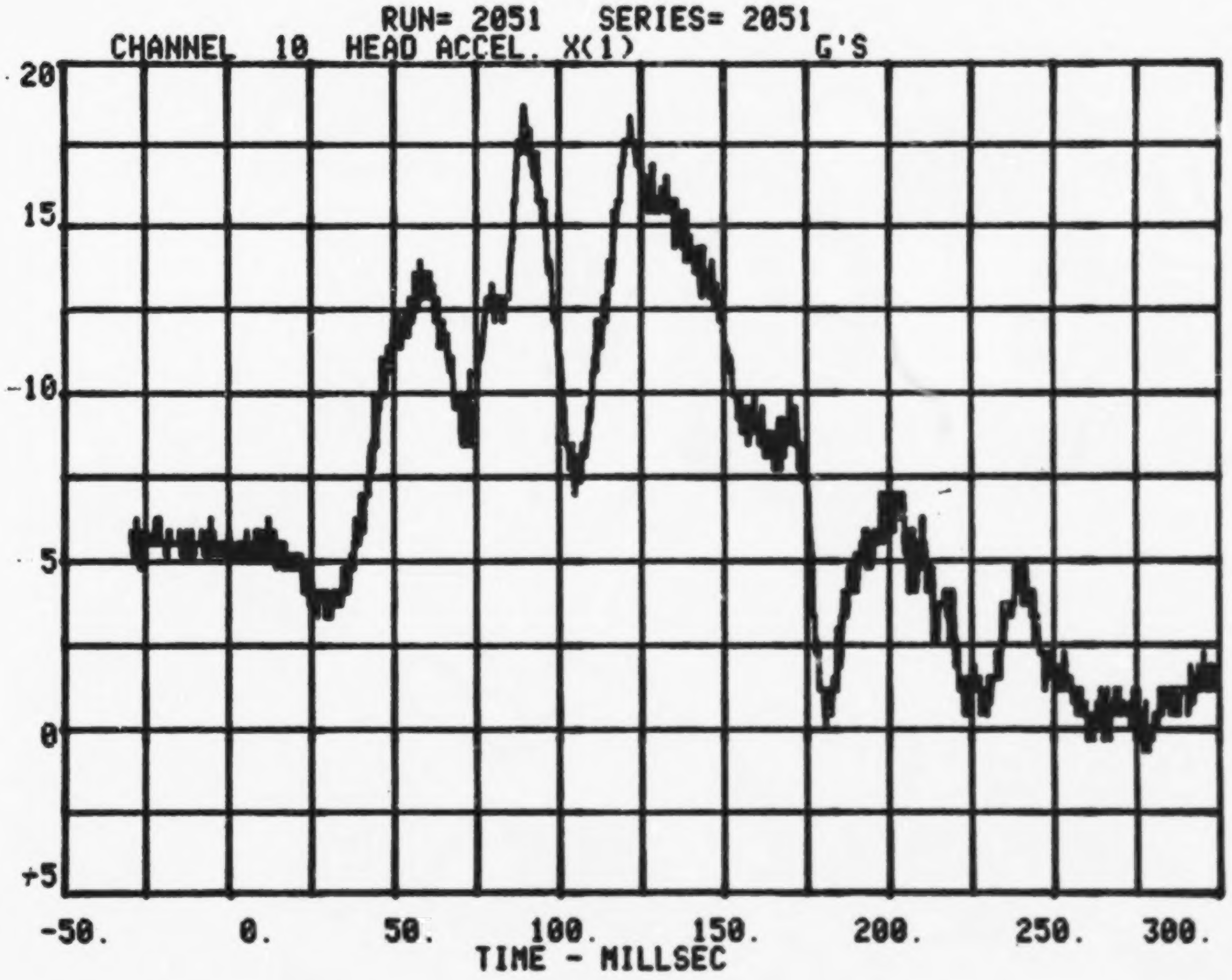
Belt Load Limiter Stroke - Left Lap, Right Lap, Shoulder

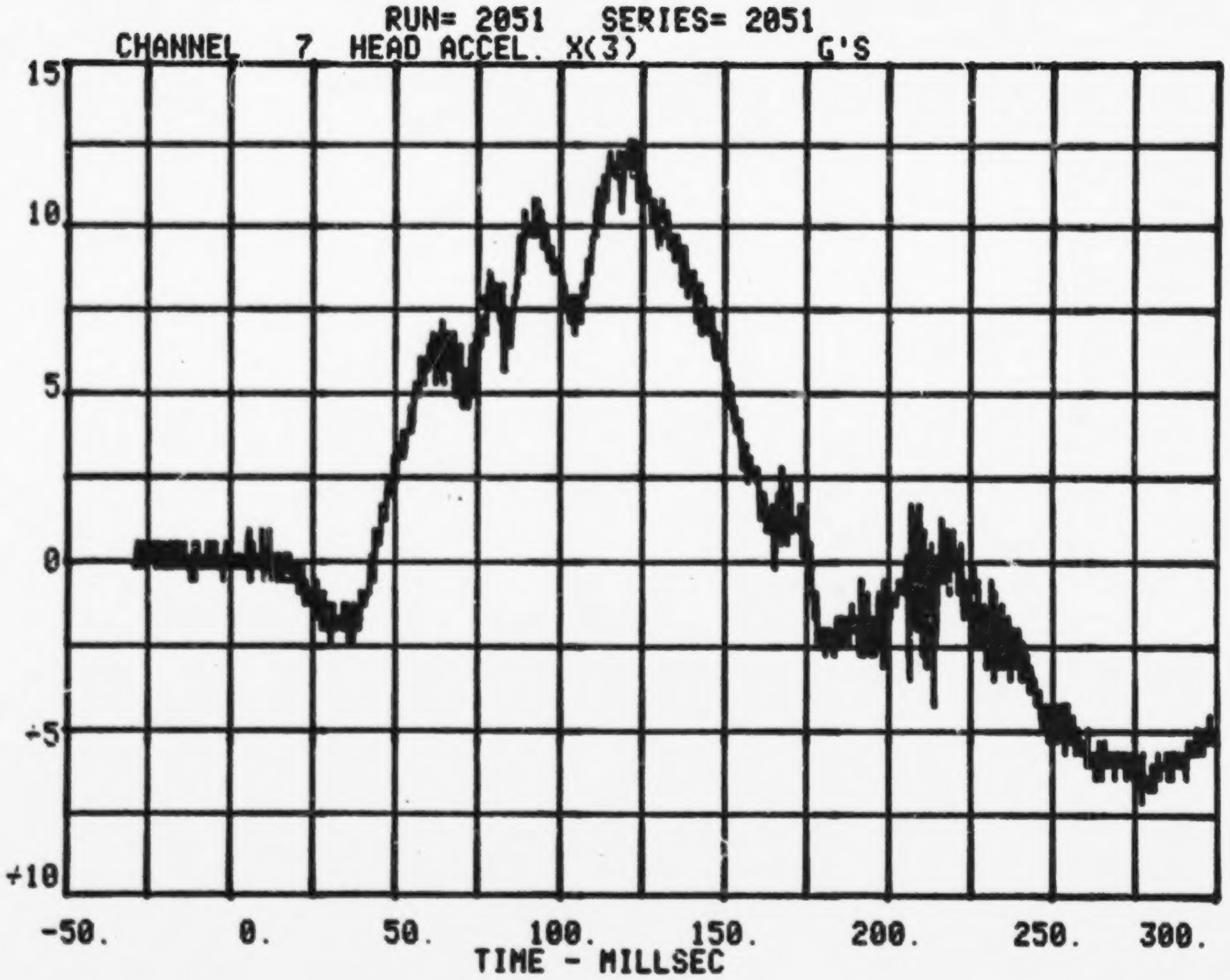
Sled Acceleration

[redacted]

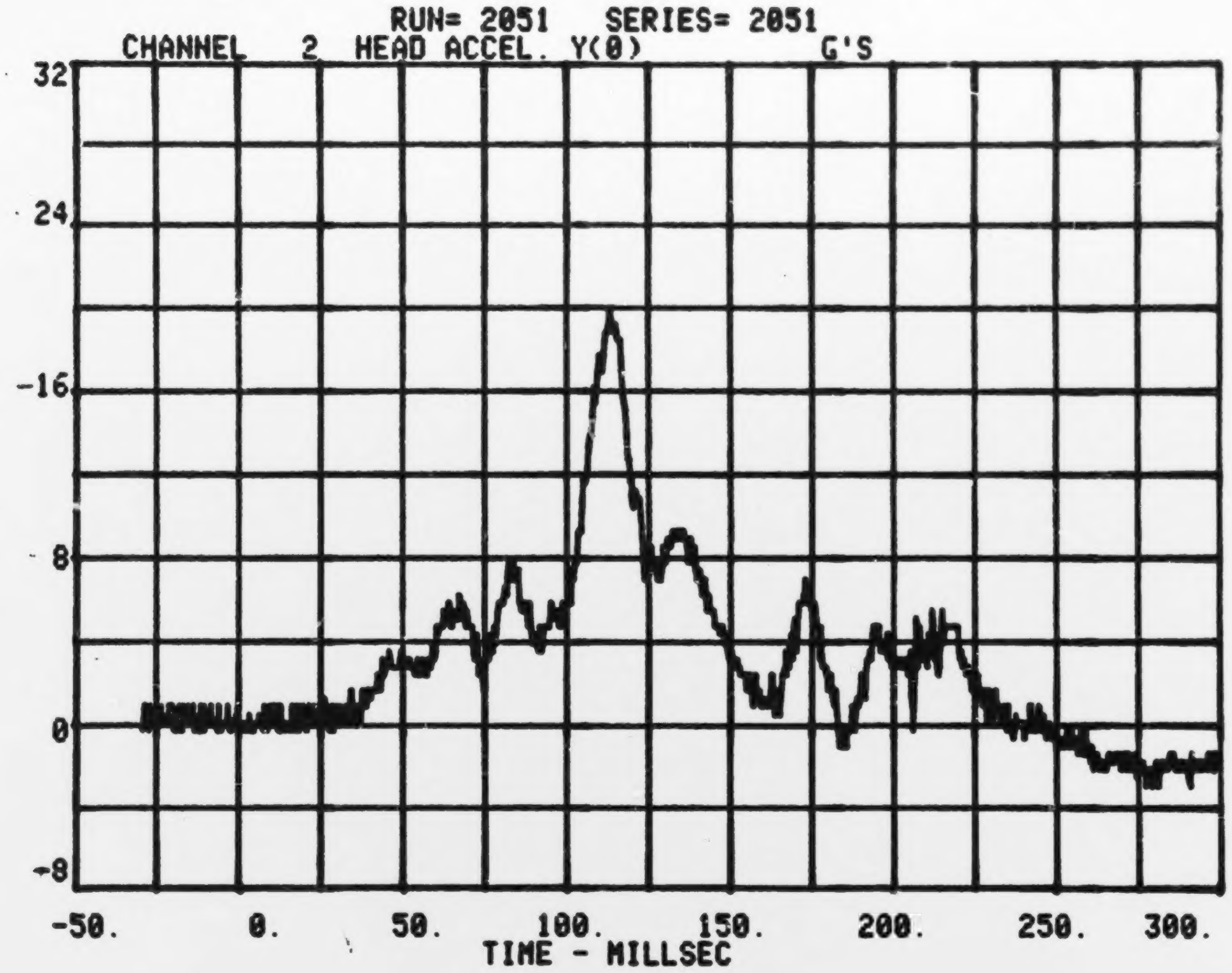
```
                  HEAD INJURY CRITERION
                   HEAD SEVERITY INDEX

              SLED TEST #2051

              RUN=2051

              RESULT. HEAD ACCEL.

       HIC= 267.3   FROM T1= .04980   TO T2= .12240

       AVERAGE ACCELERATION BETWEEN T1 AND T2=  26.7G'S

       EVENT TIME= 300.0  MSEC

       SEVERITY INDEX= 339.0
```


RUN= 2051 SERIES= 2051
CHANNEL 9 HEAD ACCEL. X(0) G'S
-15
-10
5
0
+5
+10
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051
CHANNEL 10 HEAD ACCEL. X(1) G'S
20
15
10
5
0
-5
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051
CHANNEL 7 HEAD ACCEL. X(3) G'S
15
10
5
0
-5
-10
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE



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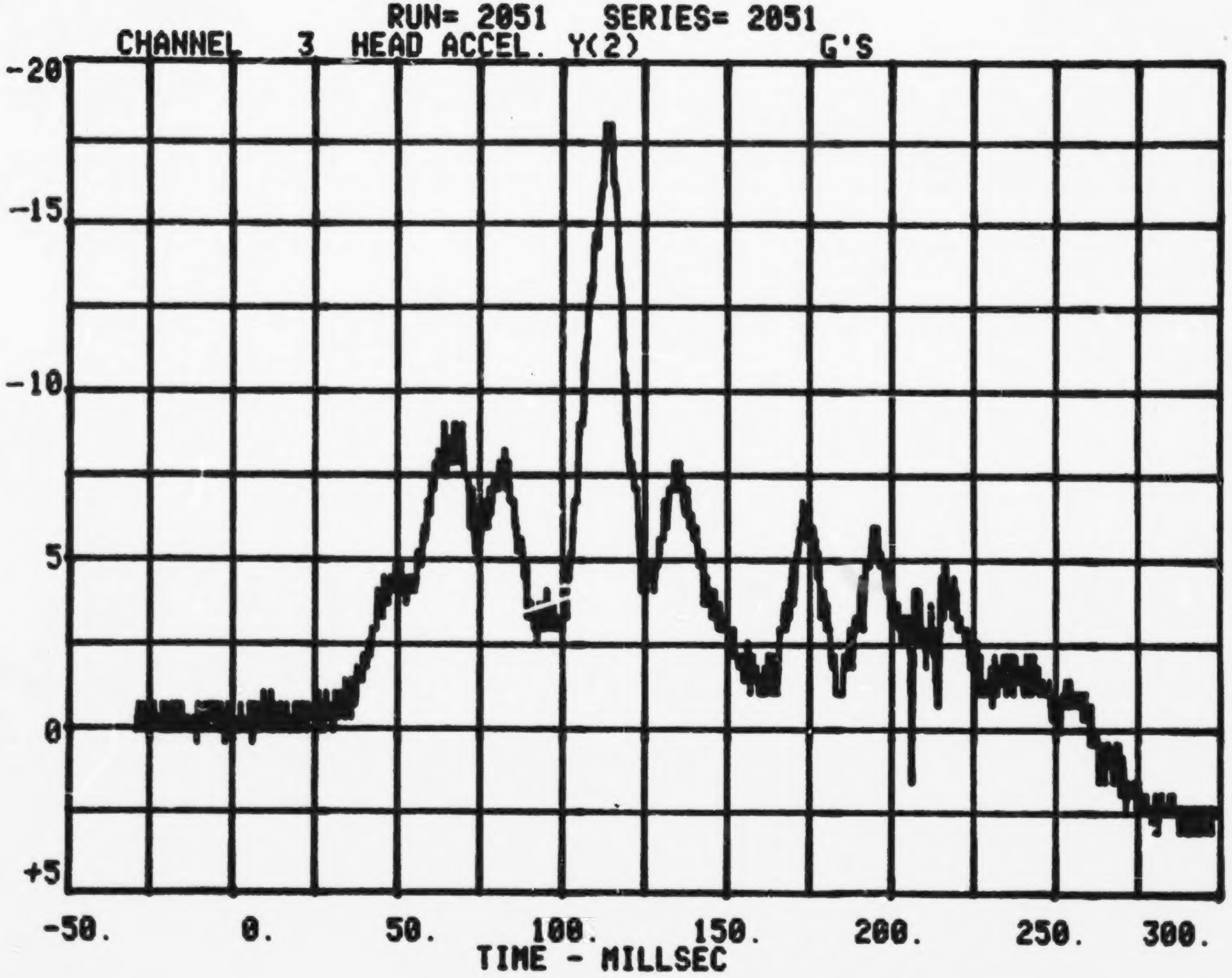
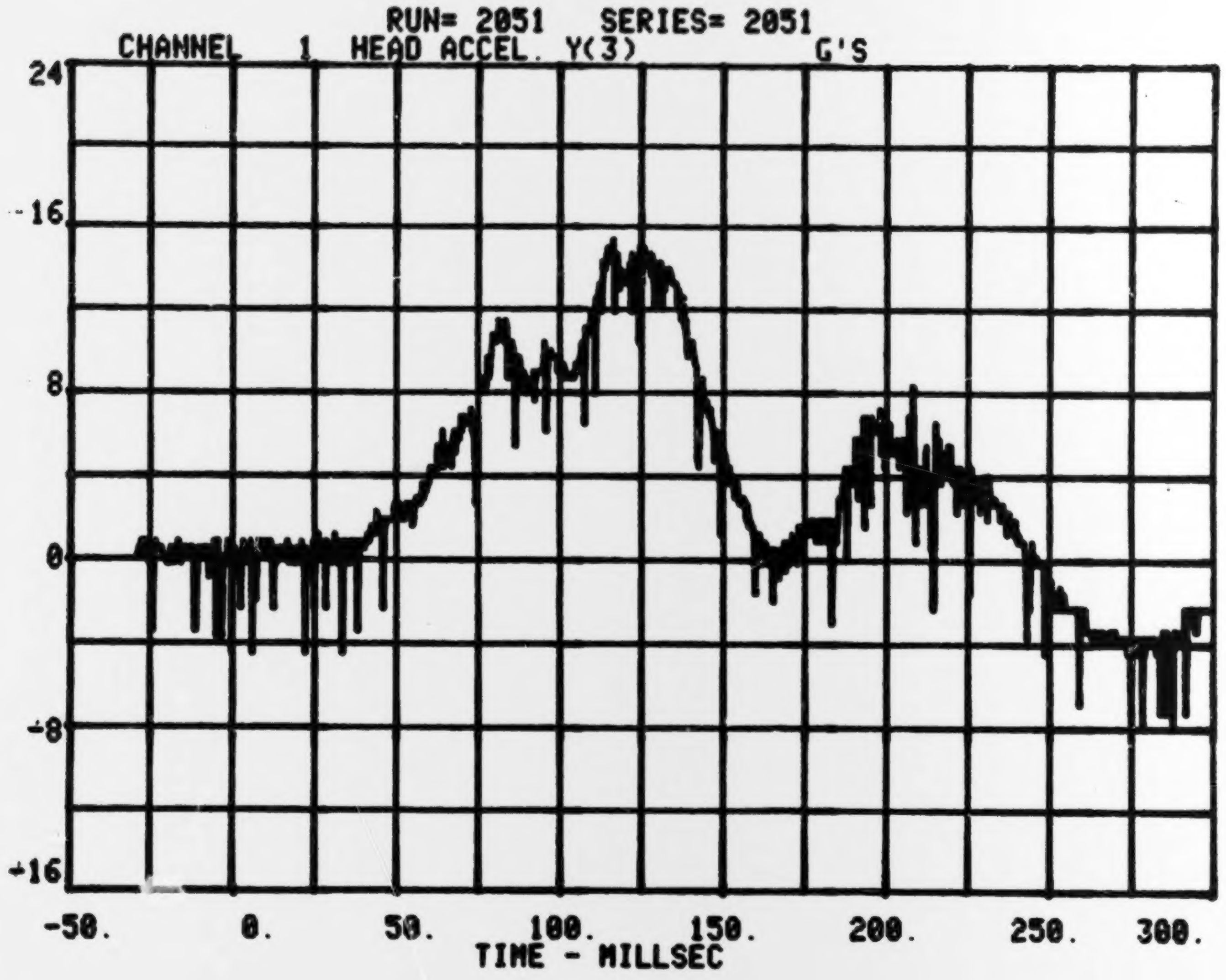
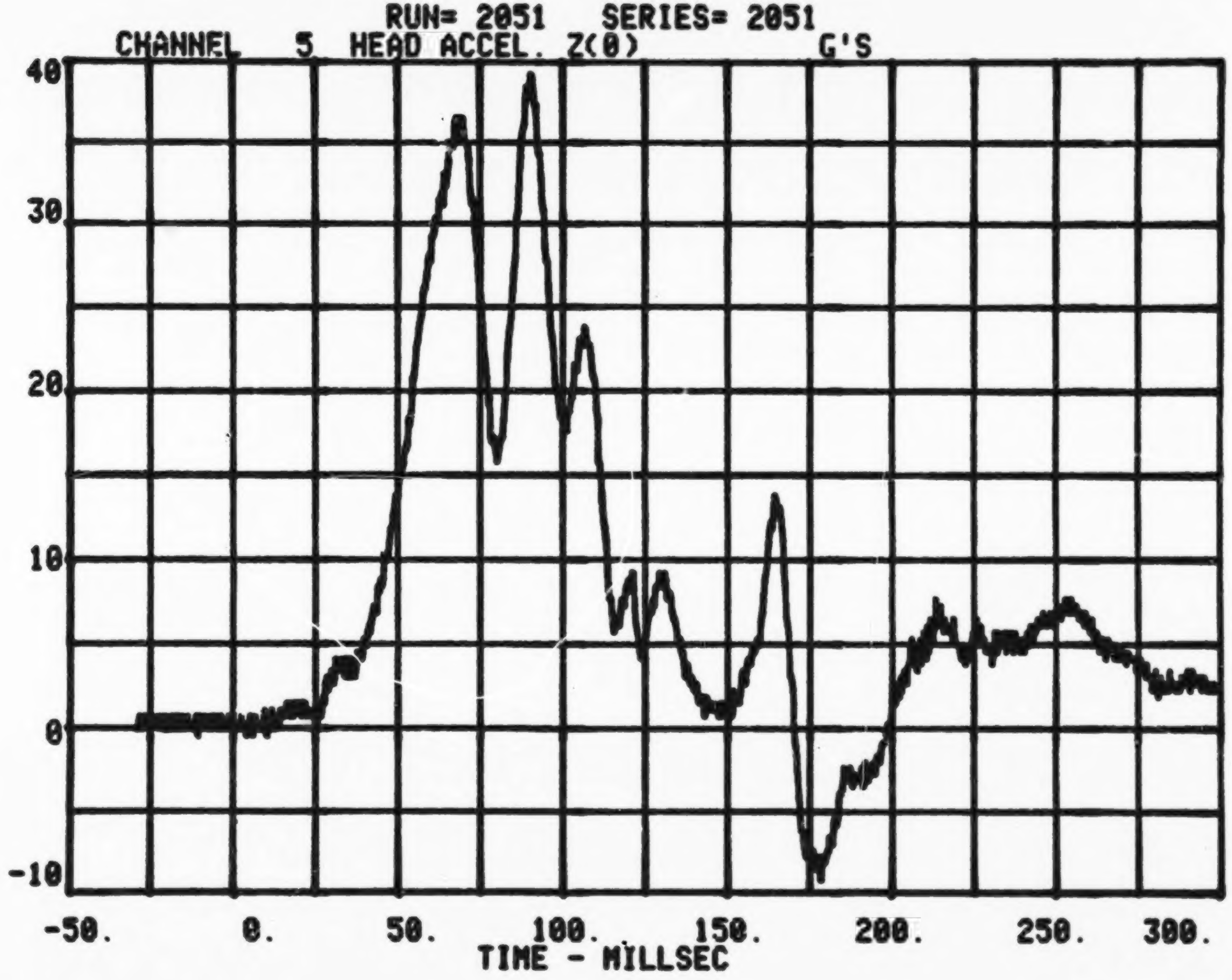
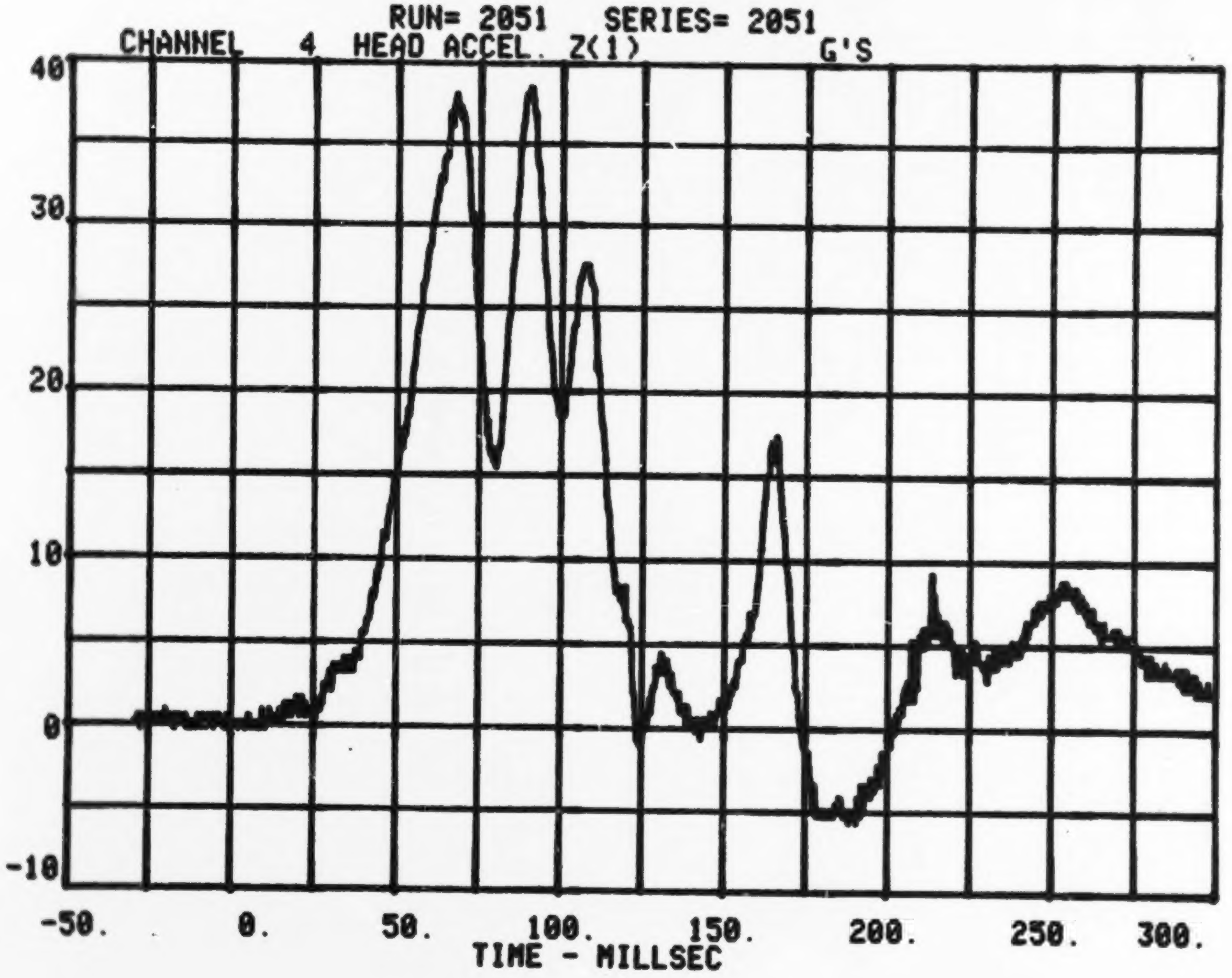
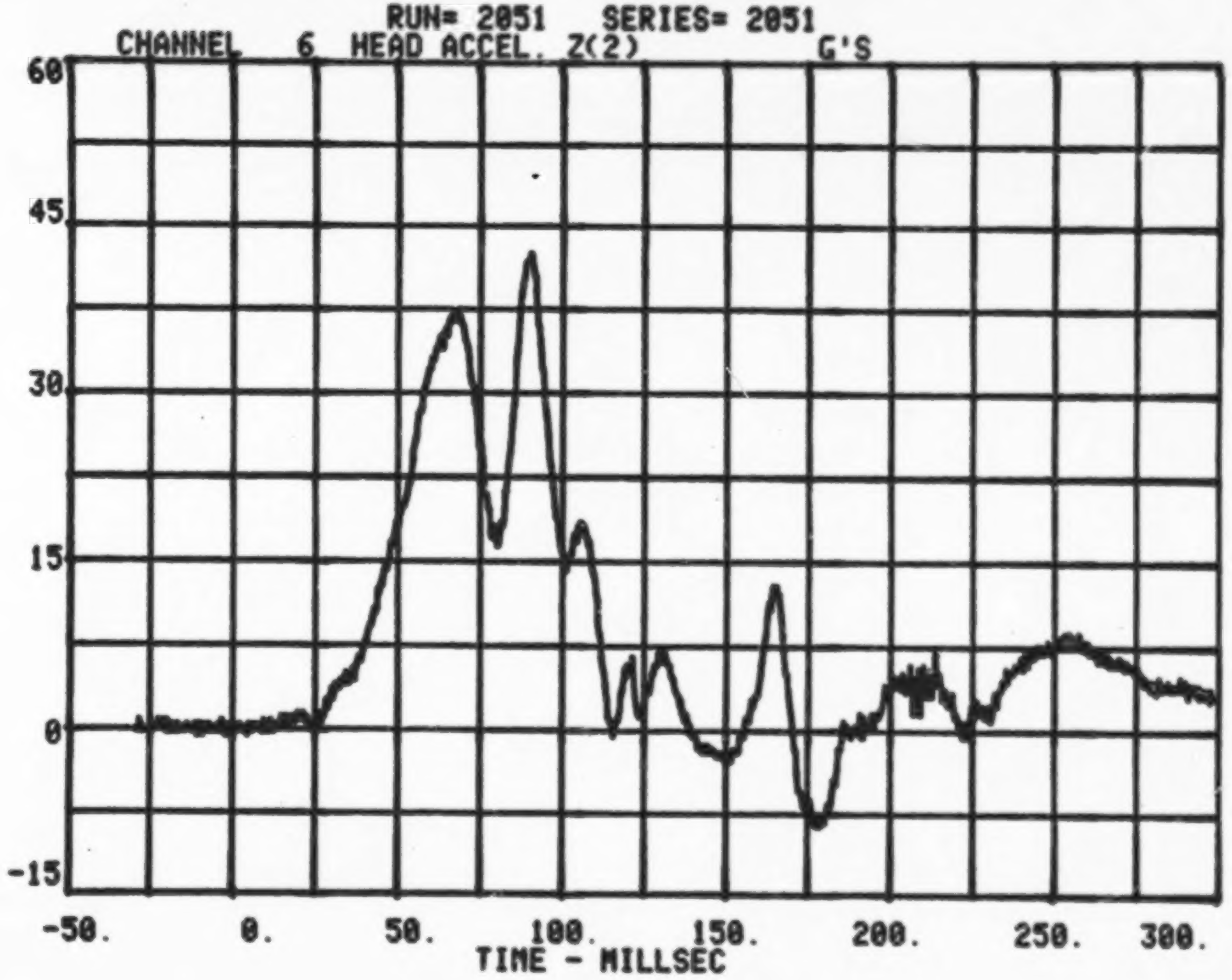



RUN= 2051 SERIES= 2051
CHANNEL 1 HEAD ACCEL. Y(3) G'S
24
16
8
0
-8
-16
-16
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

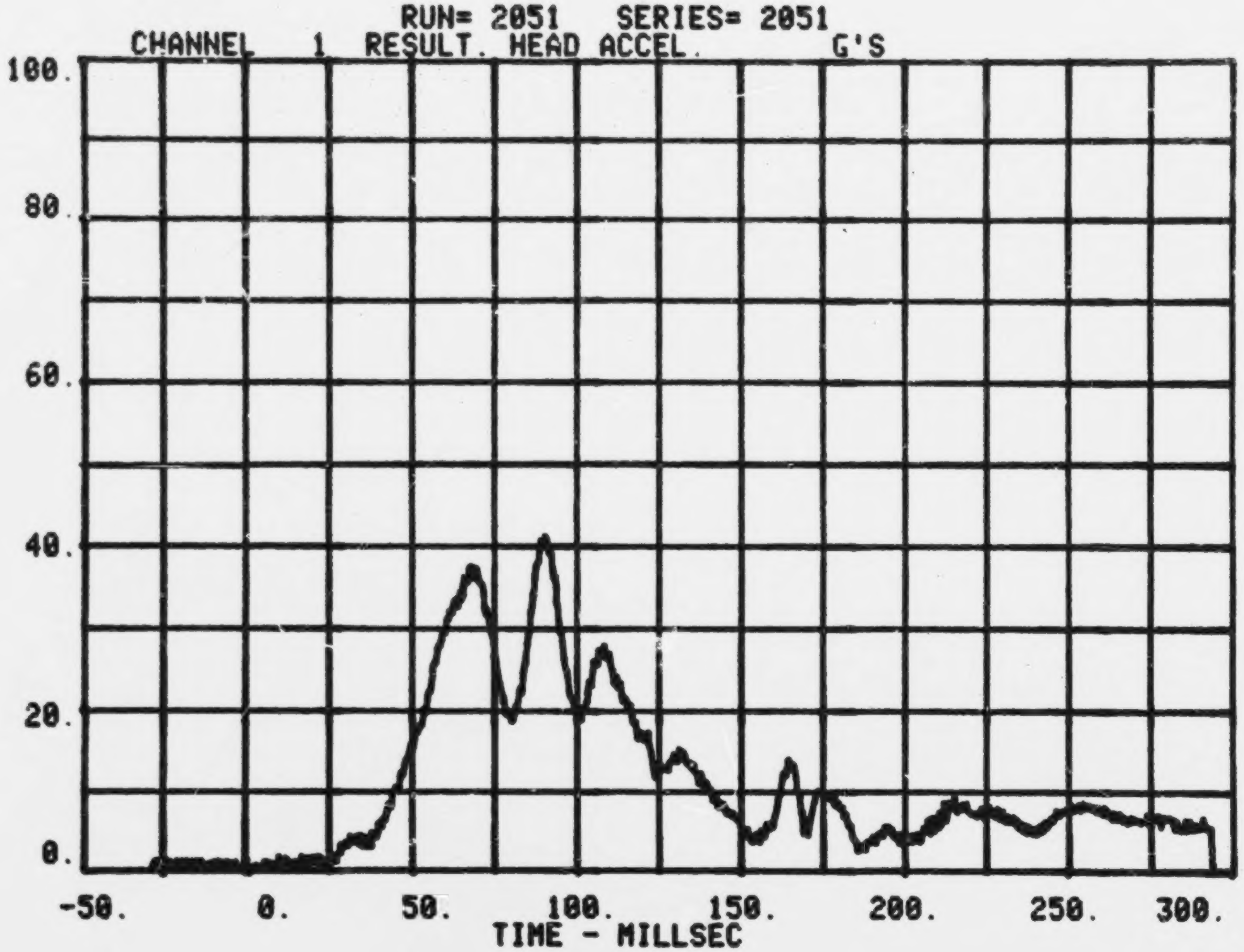

RUN= 2051 SERIES= 2051
CHANNEL 5 HEAD ACCEL. Z(0) G'S
40
30
20
10
0
-10
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE




RUN= 2051 SERIES= 2051
CHANNEL 6 HEAD ACCEL. Z(2) G'S
60
45
30
15
0
-15
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE



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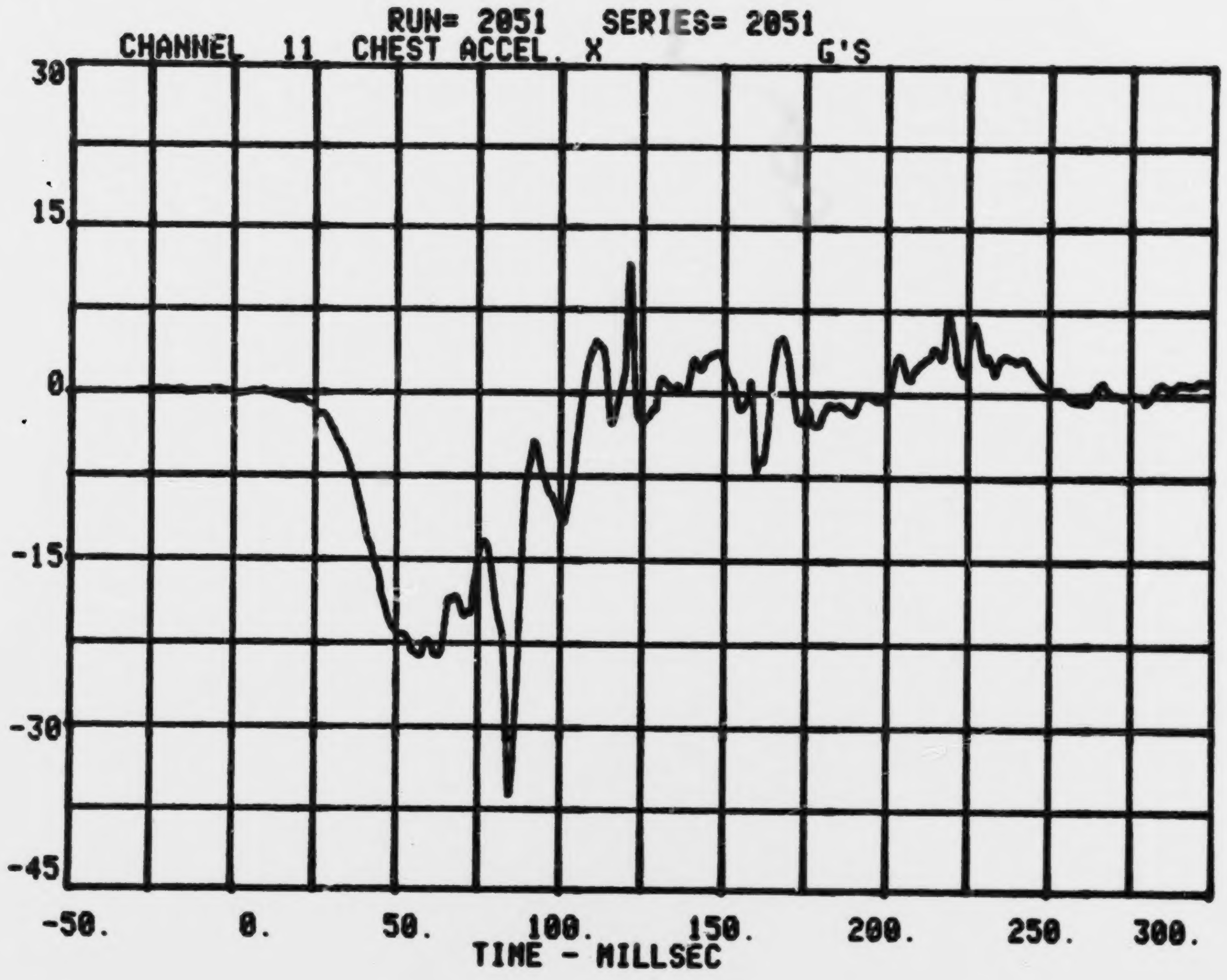
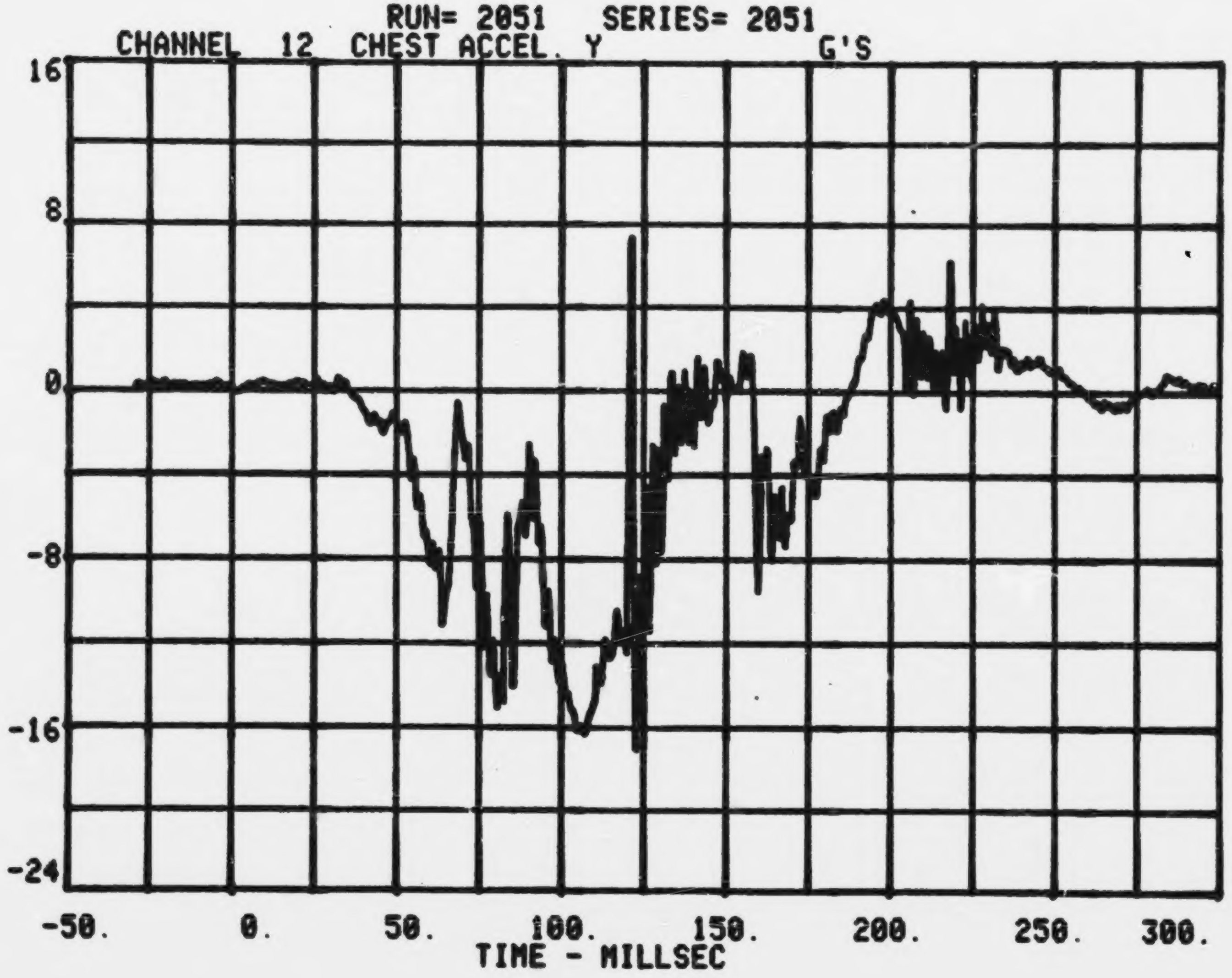
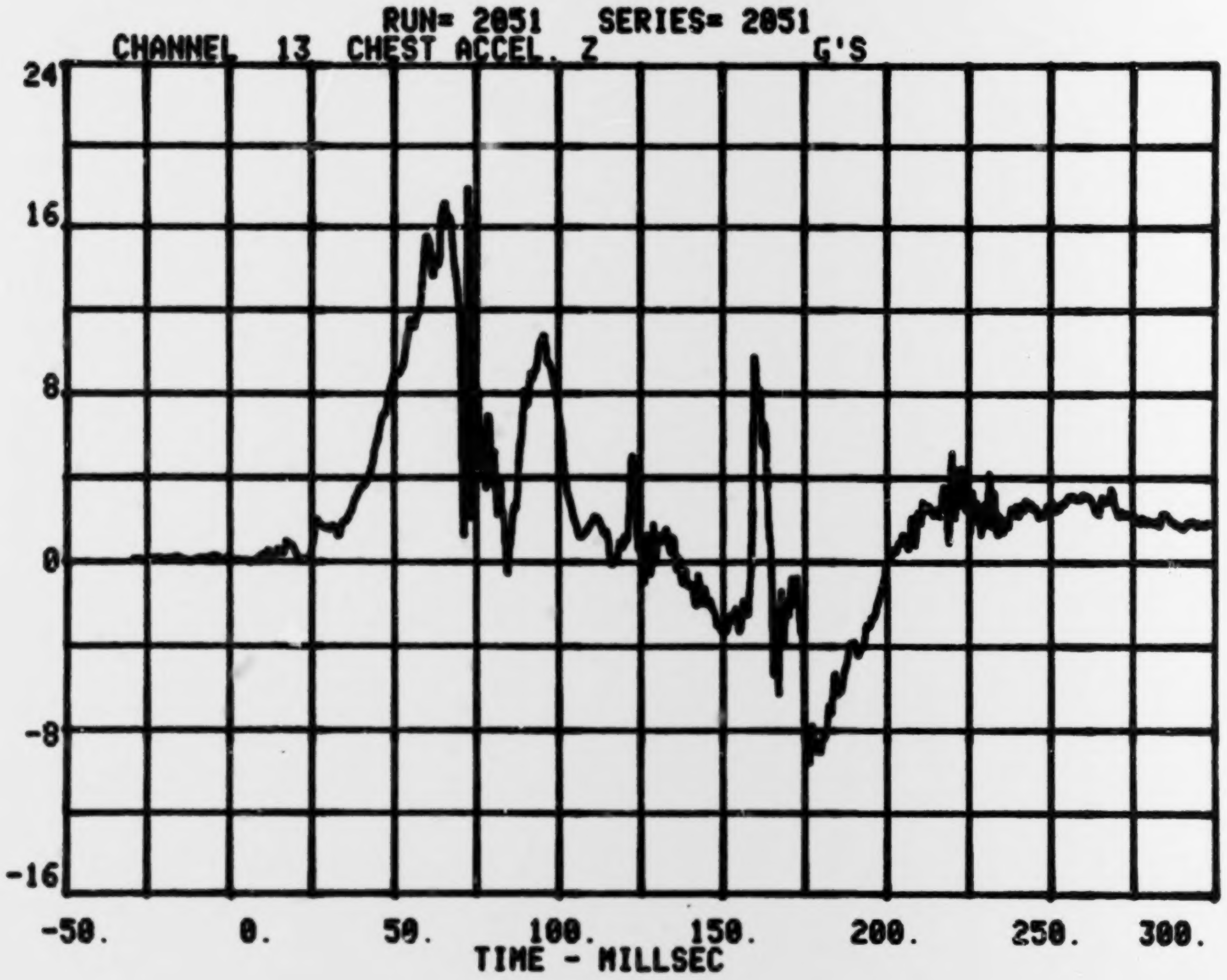
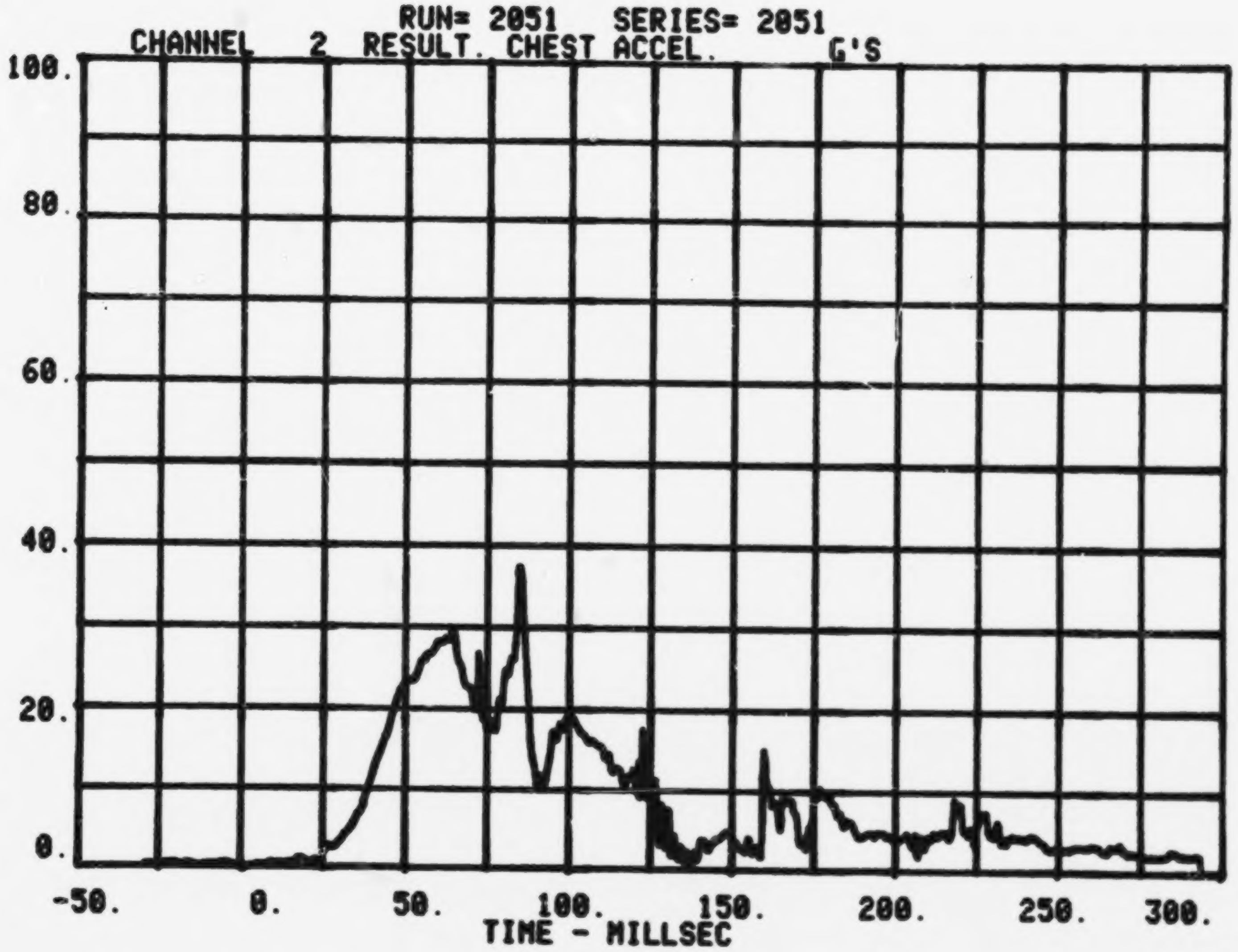
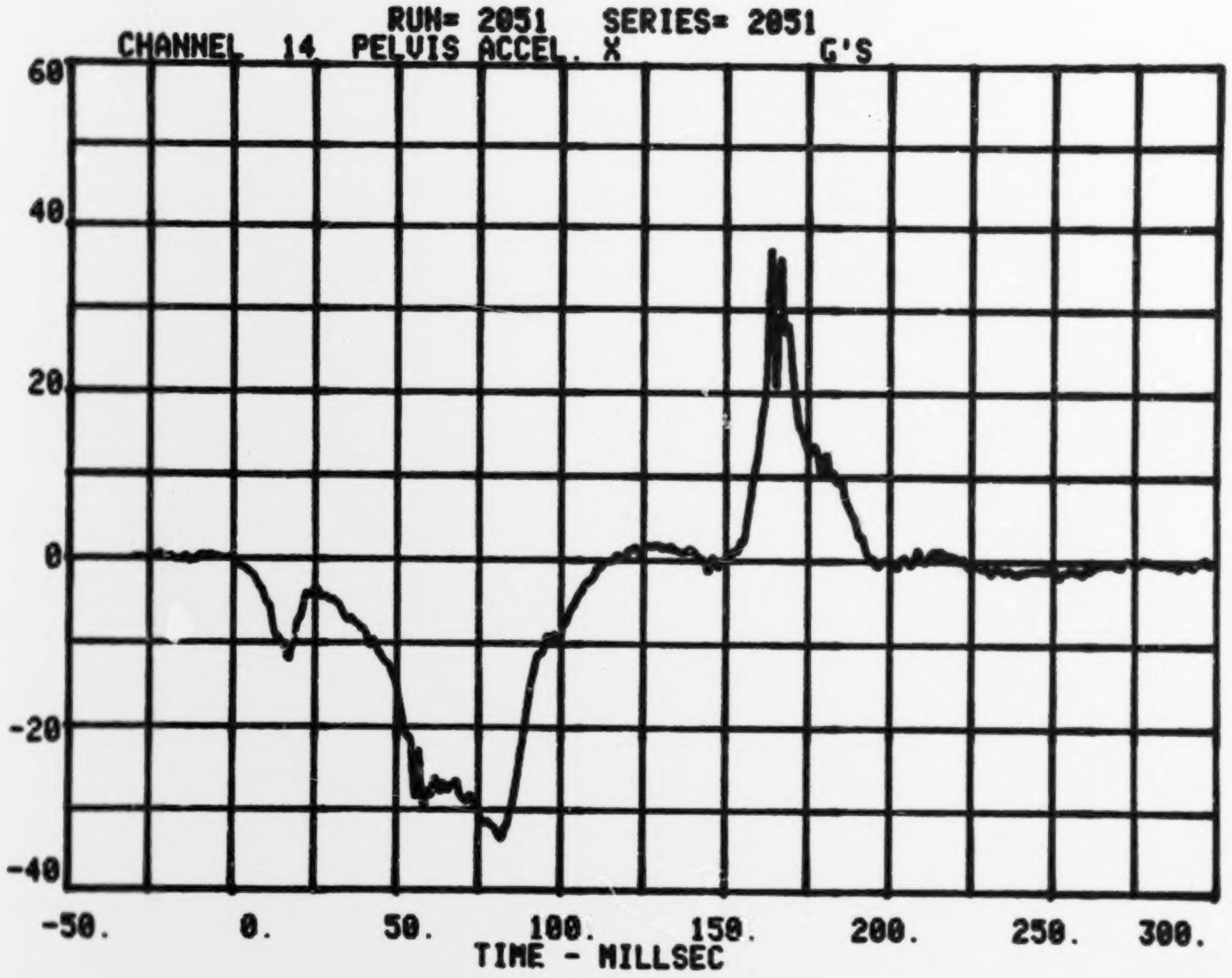


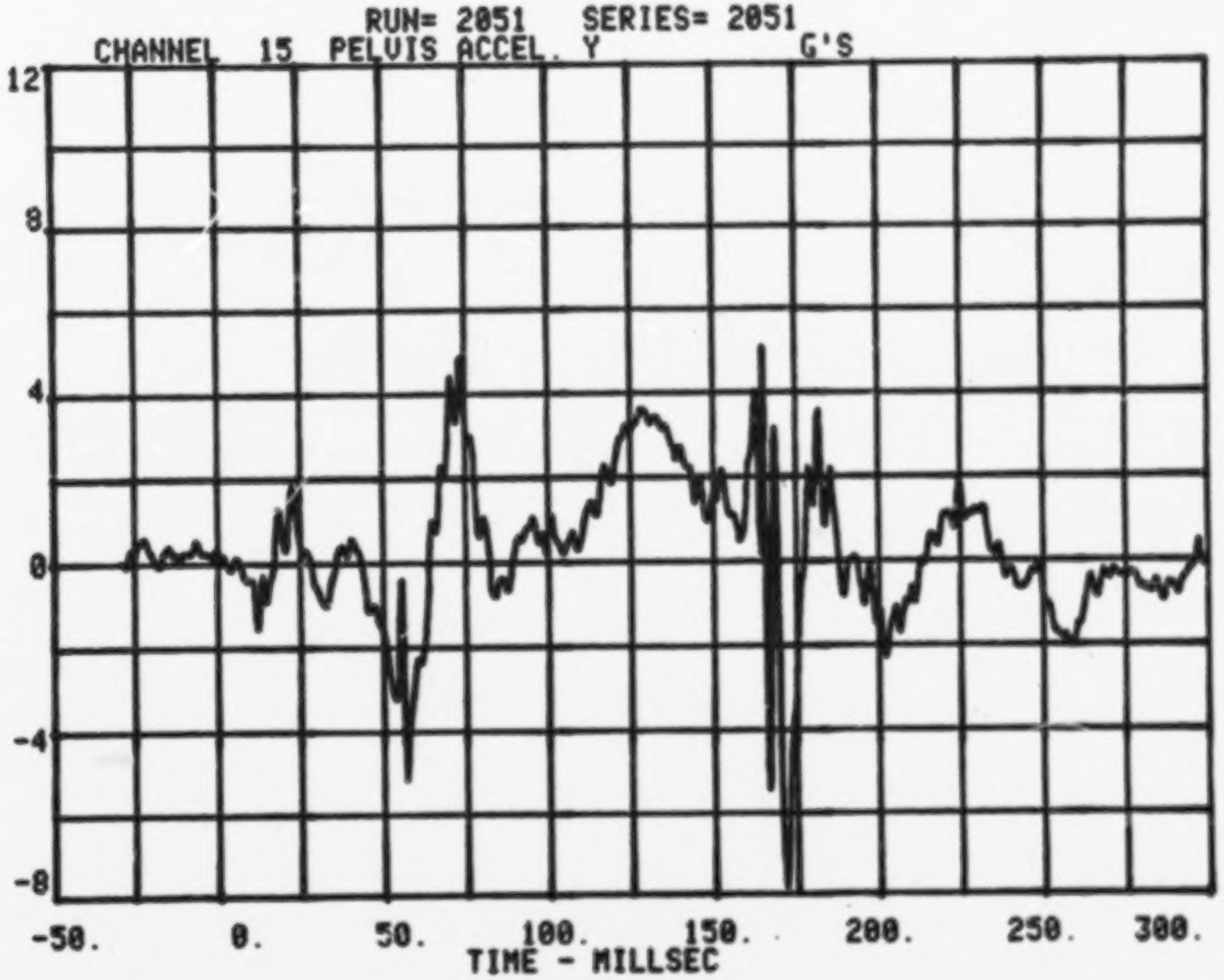
BEST DOCUMENT AVAILABLE



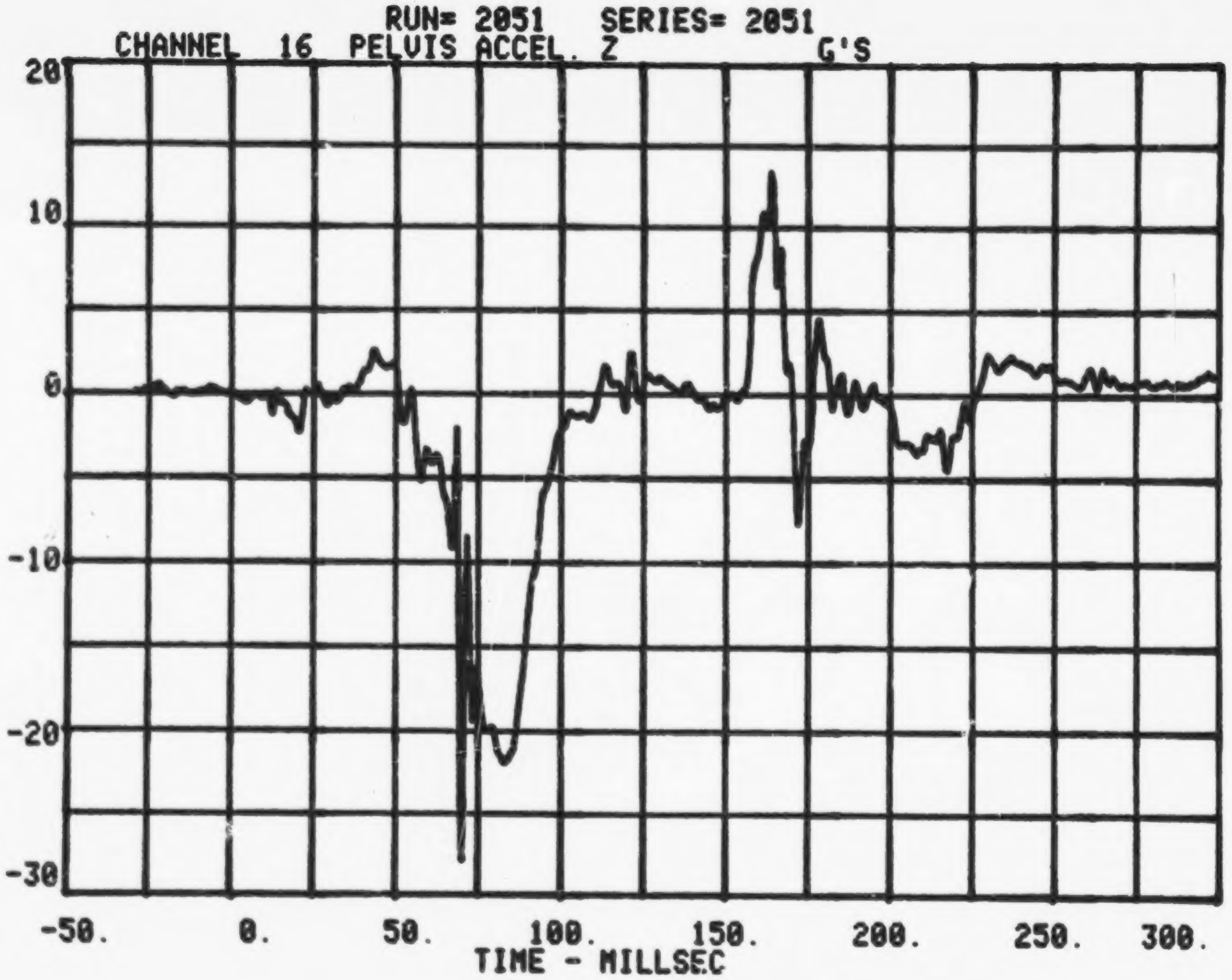

RUN= 2051 SERIES= 2051
CHANNEL 13 CHEST ACCEL. Z
G'S
24
16
8
0
-8
-16
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051
CHANNEL 2 RESULT. CHEST ACCEL. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051
CHANNEL 14 PELVIS ACCEL. X G'S
60
40
20
0
-20
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051

CHANNEL 15 PELVIS ACCEL. Y G'S

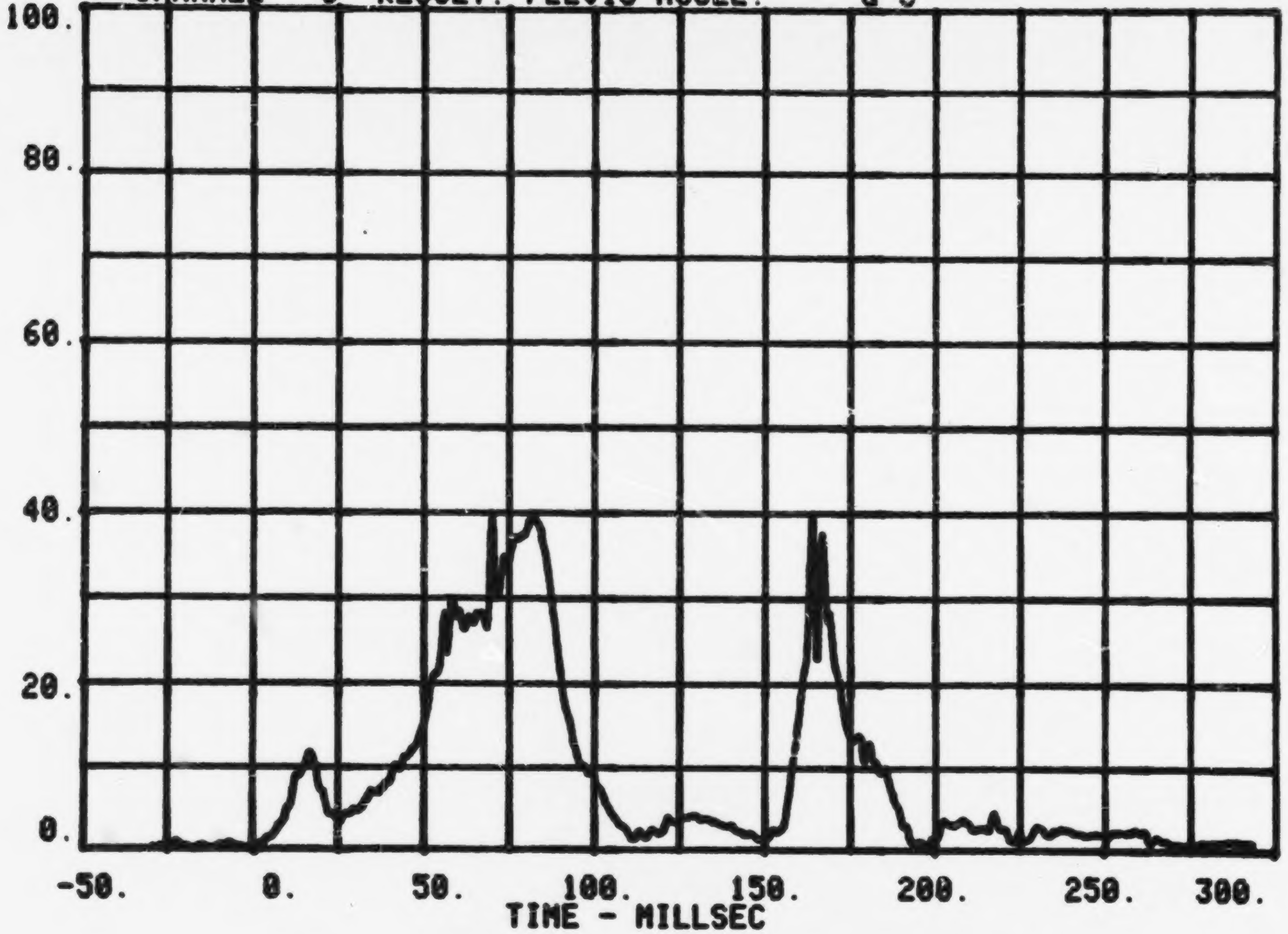


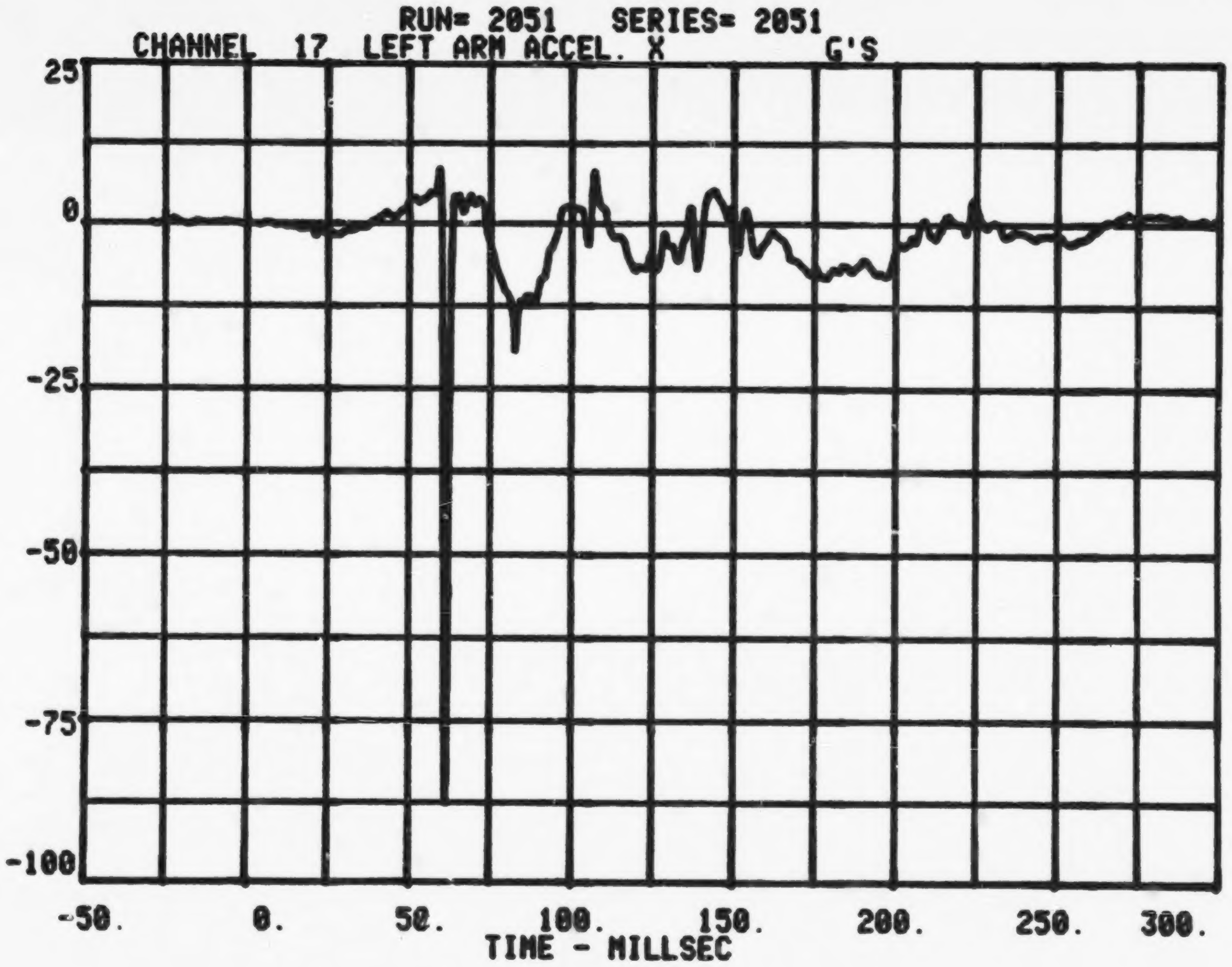
RUN= 2051 SERIES= 2051

CHANNEL 16 PELVIS ACCEL. Z G'S

RUN= 2051 SERIES= 2051

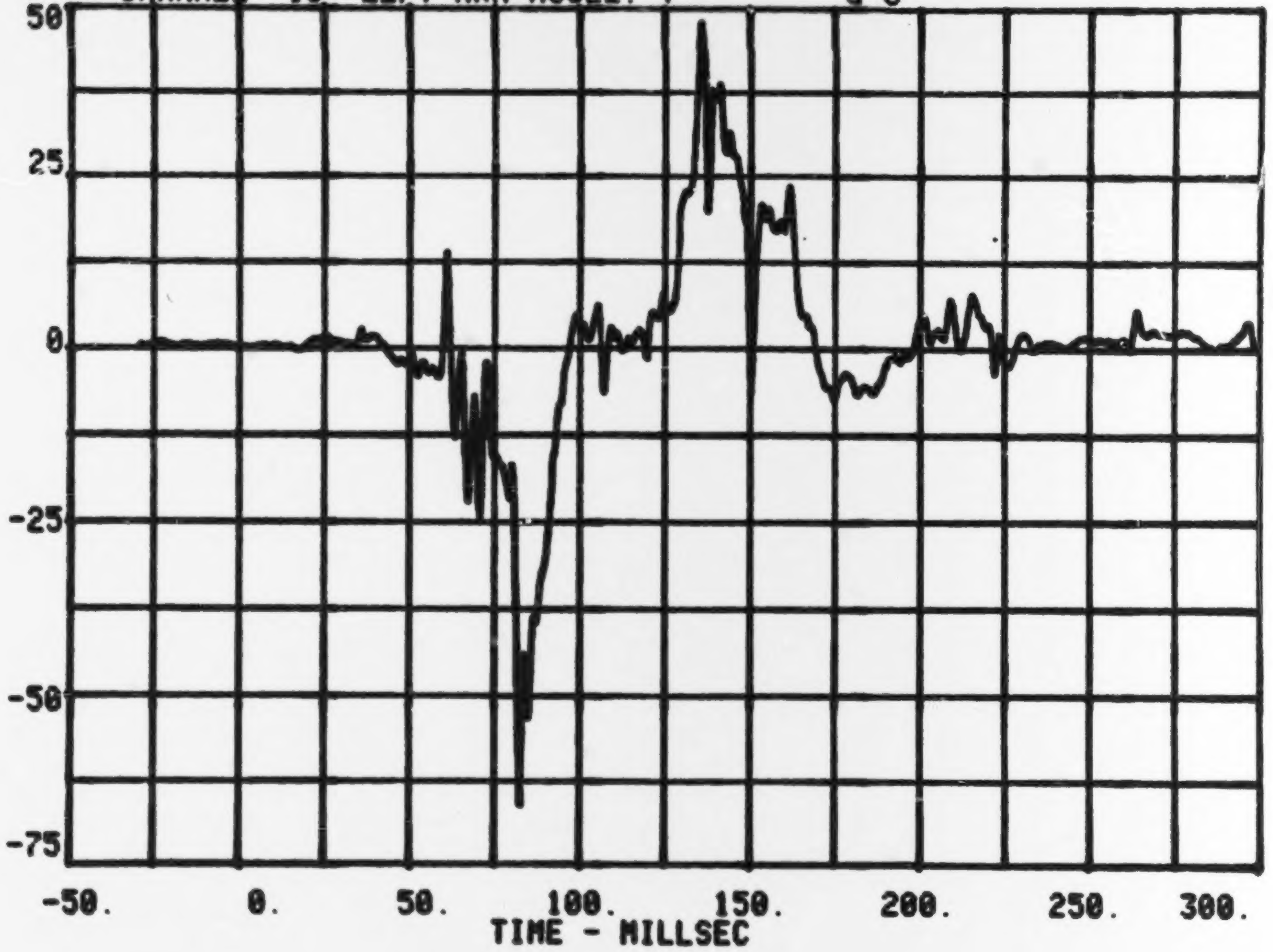
CHANNEL 3 RESULT. PELVIS ACCEL. G'S

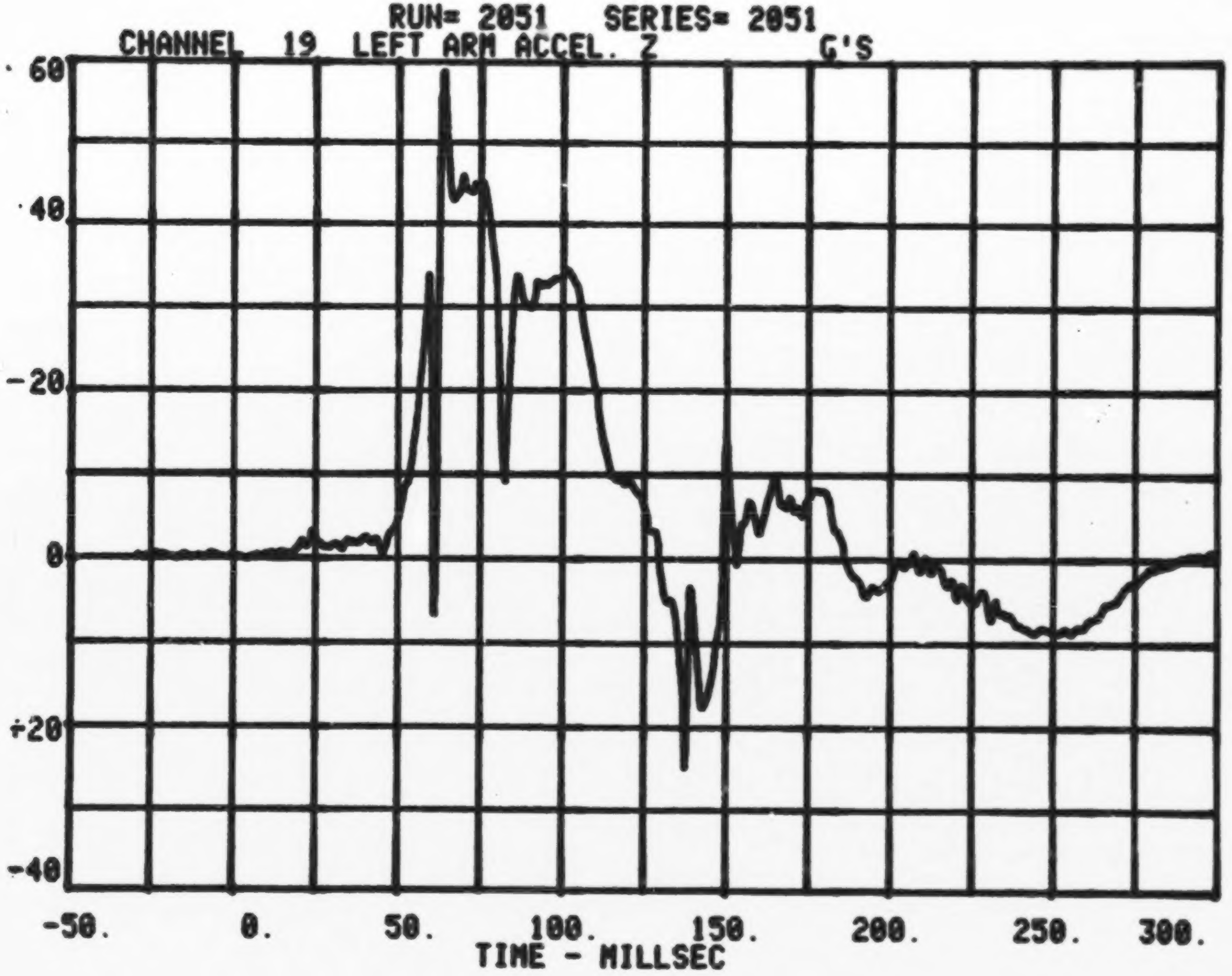



RUN= 2051 SERIES= 2051
CHANNEL 17 LEFT ARM ACCEL. X G'S
25
0
-25
-50
-75
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

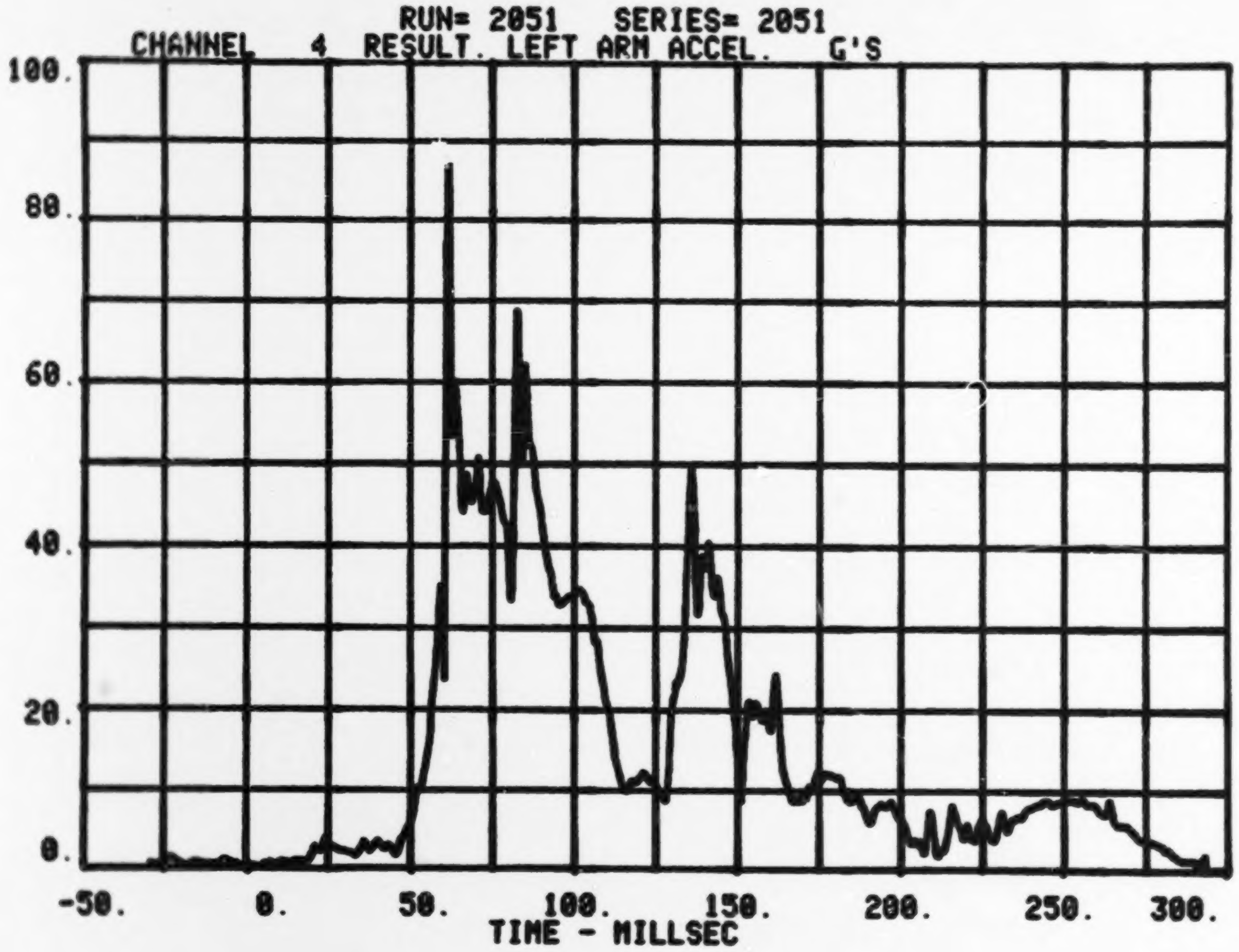
RUN= 2051 SERIES= 2051

CHANNEL 18 LEFT ARM ACCEL. Y G'S




RUN= 2051 SERIES= 2051
CHANNEL 19 LEFT ARM ACCEL. Z G'S
60
40
-20
0
-20
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE



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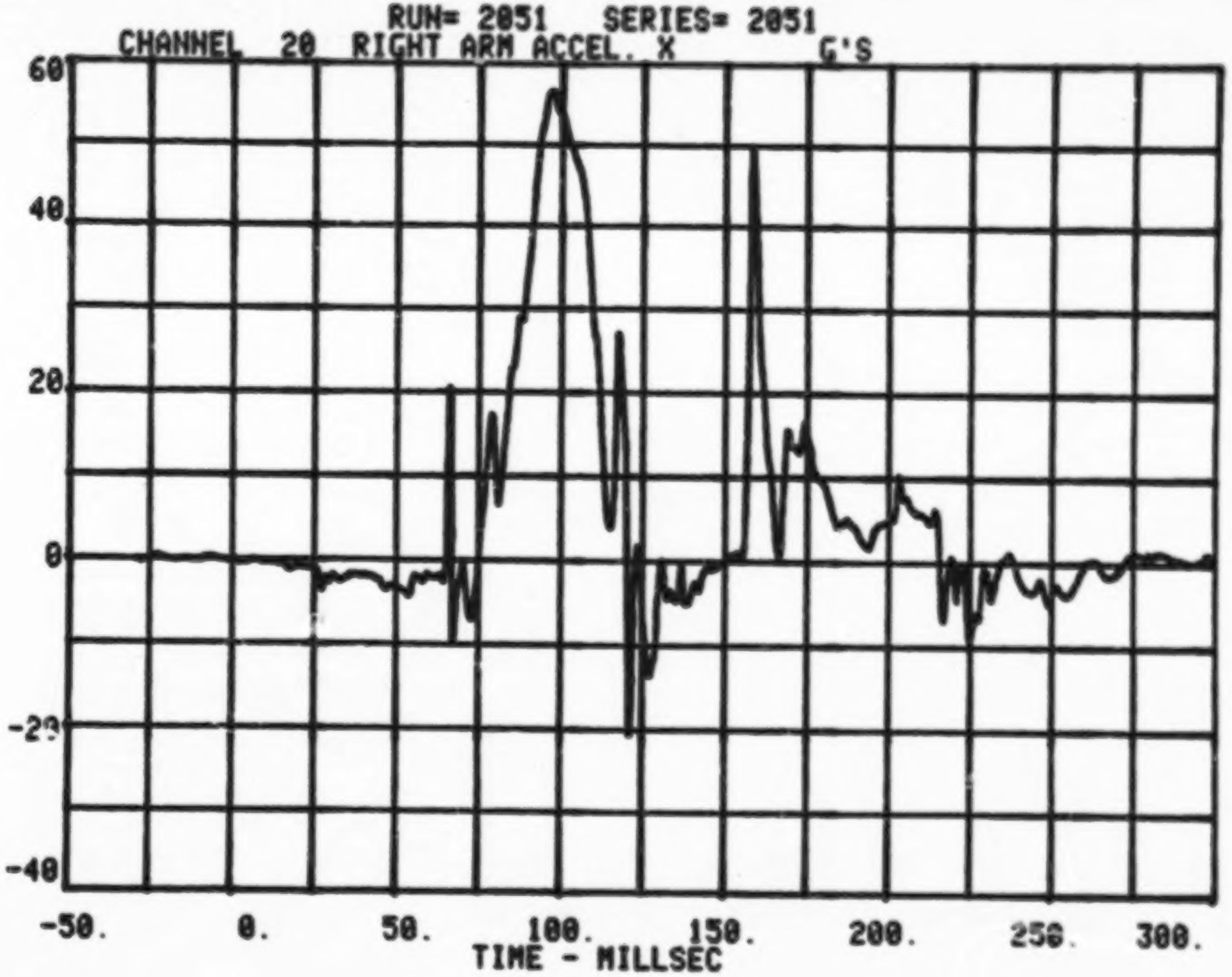
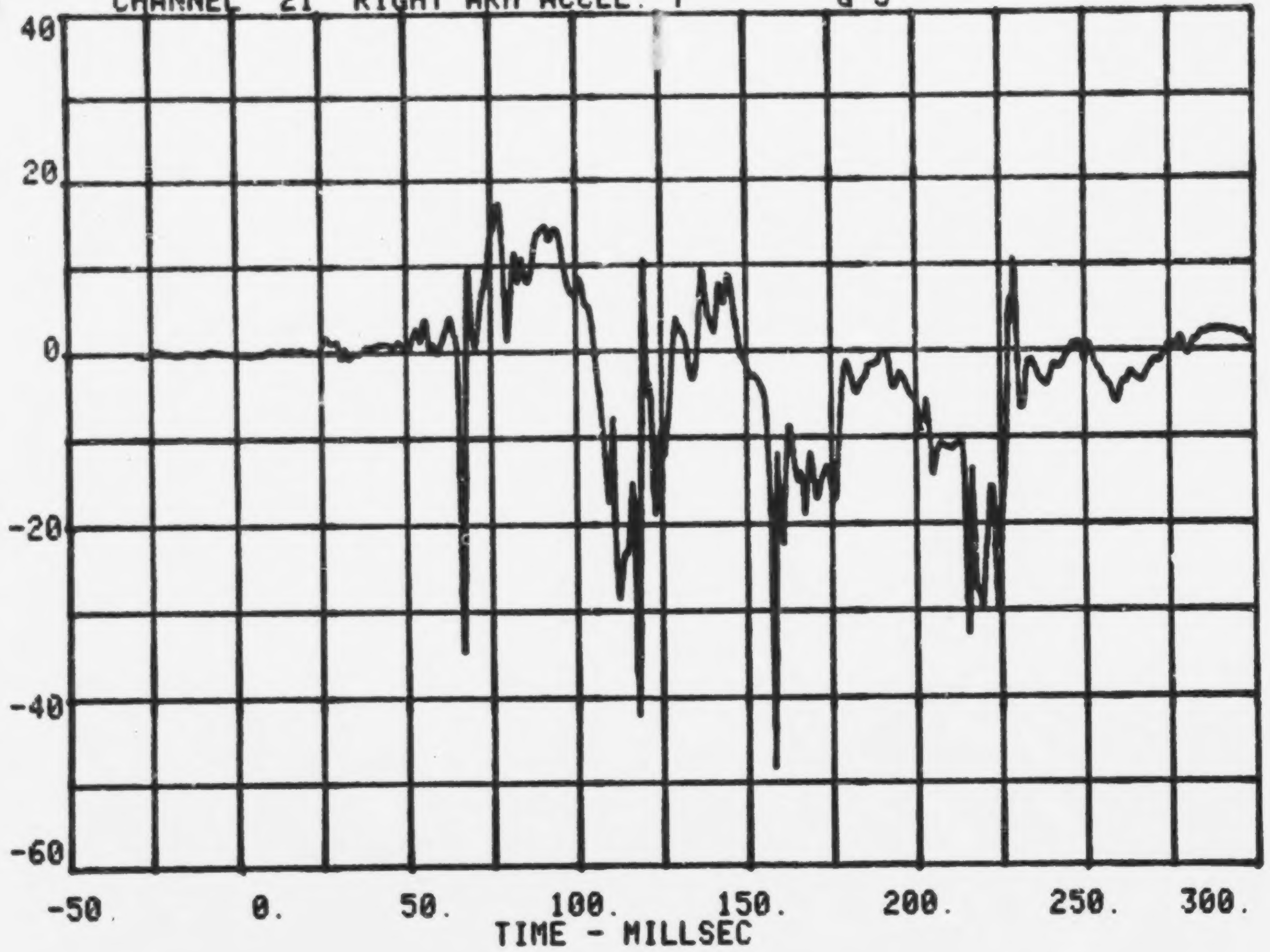
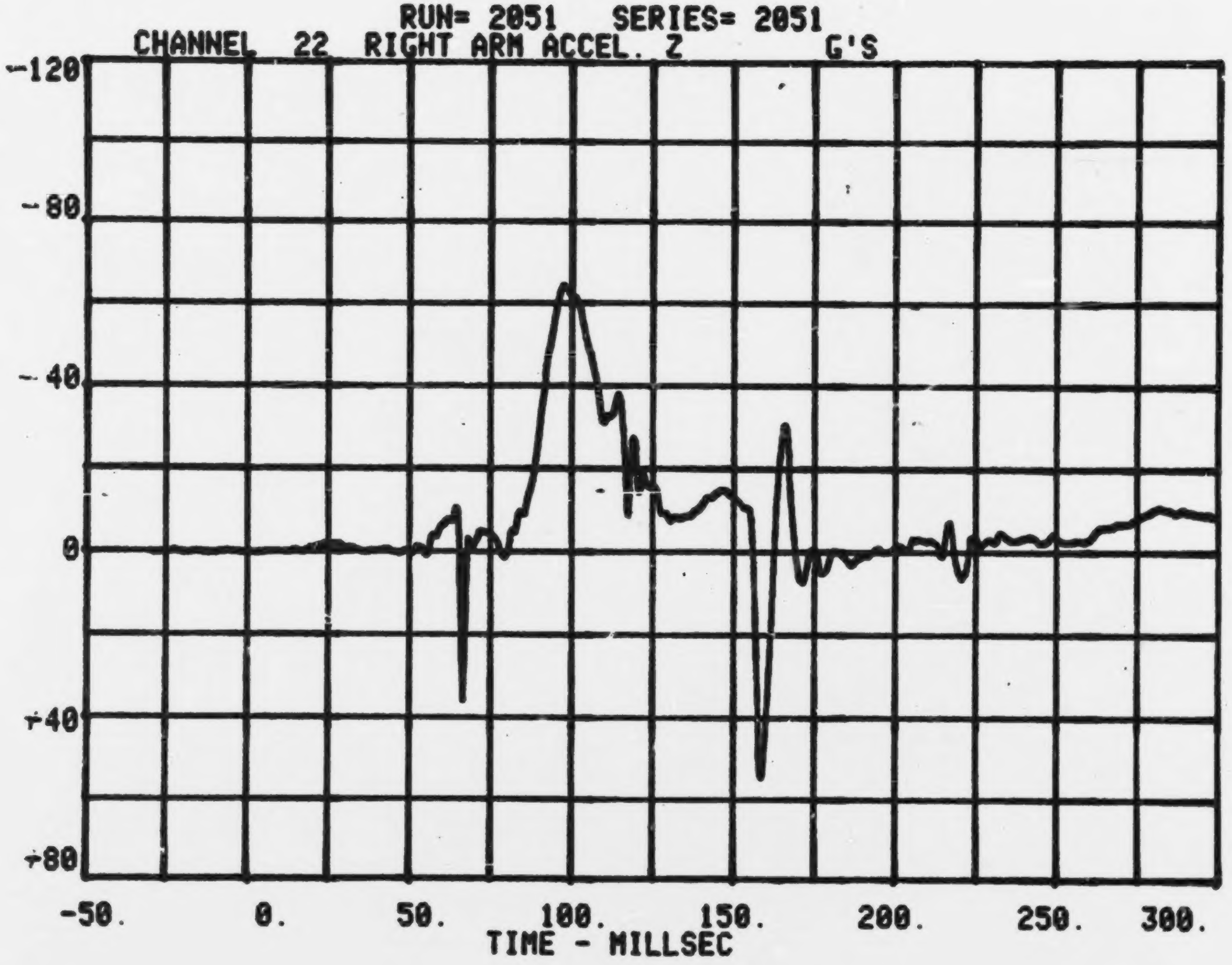


BEST DOCUMENT AVAILABLE

RUN= 2051   SERIES= 2051

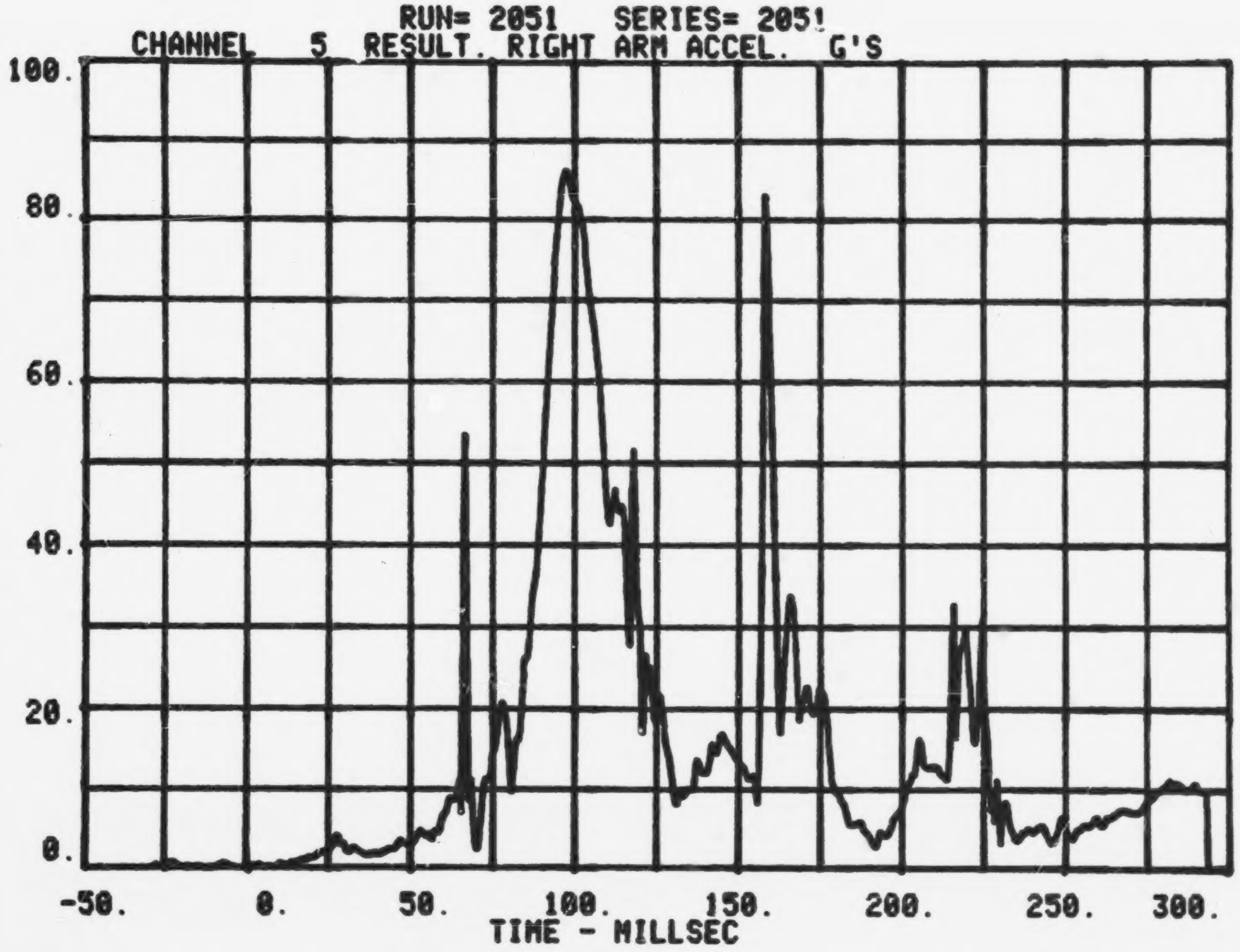
CHANNEL 21 RIGHT ARM ACCEL. Y   G'S




RUN= 2051 SERIES= 2051
CHANNEL 22 RIGHT ARM ACCEL. Z G'S
-120
-80
-40
0
+40
+80
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE

RUN= 2051 SERIES= 2051
CHANNEL 5 RESULT. RIGHT ARM ACCEL. G'S



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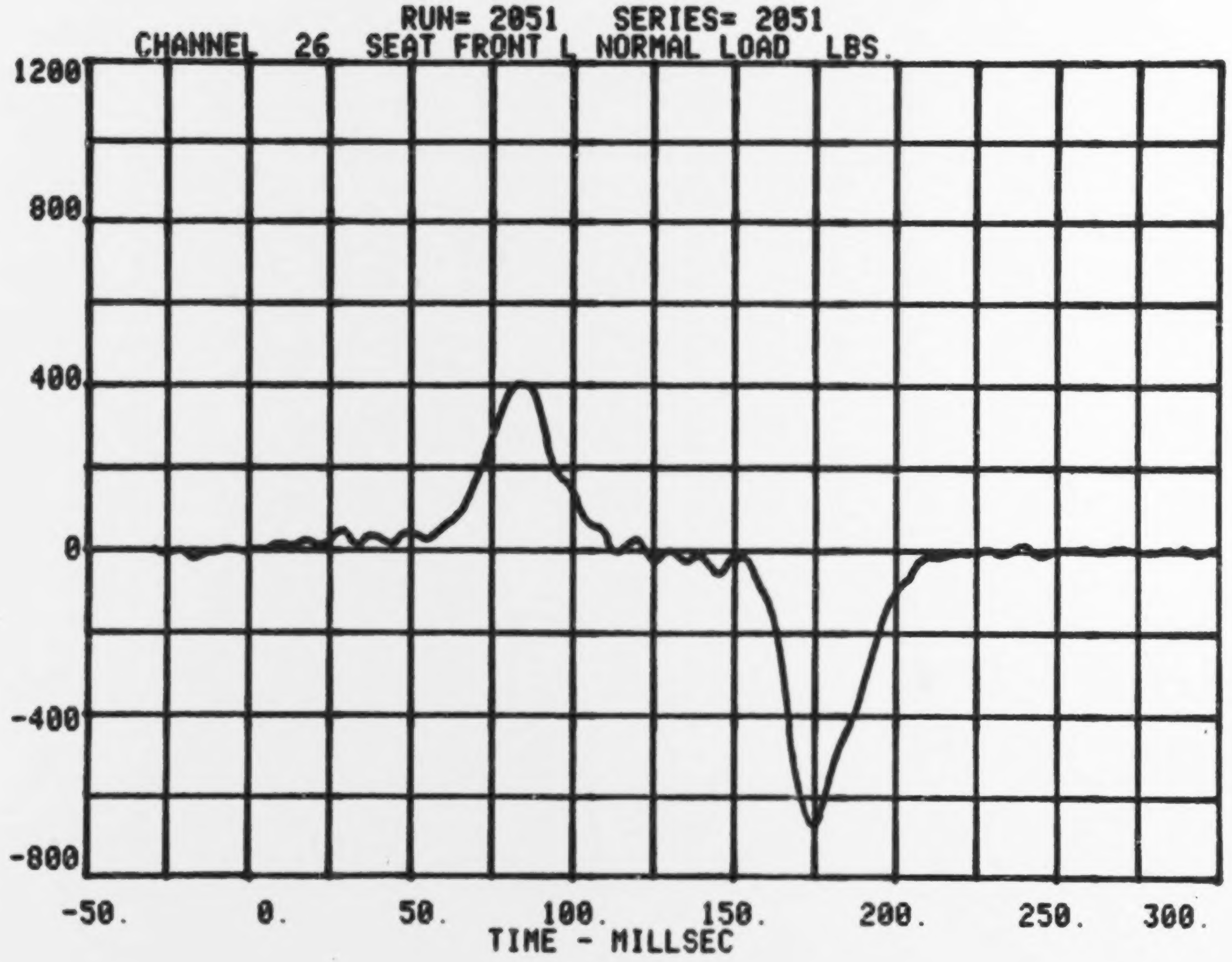
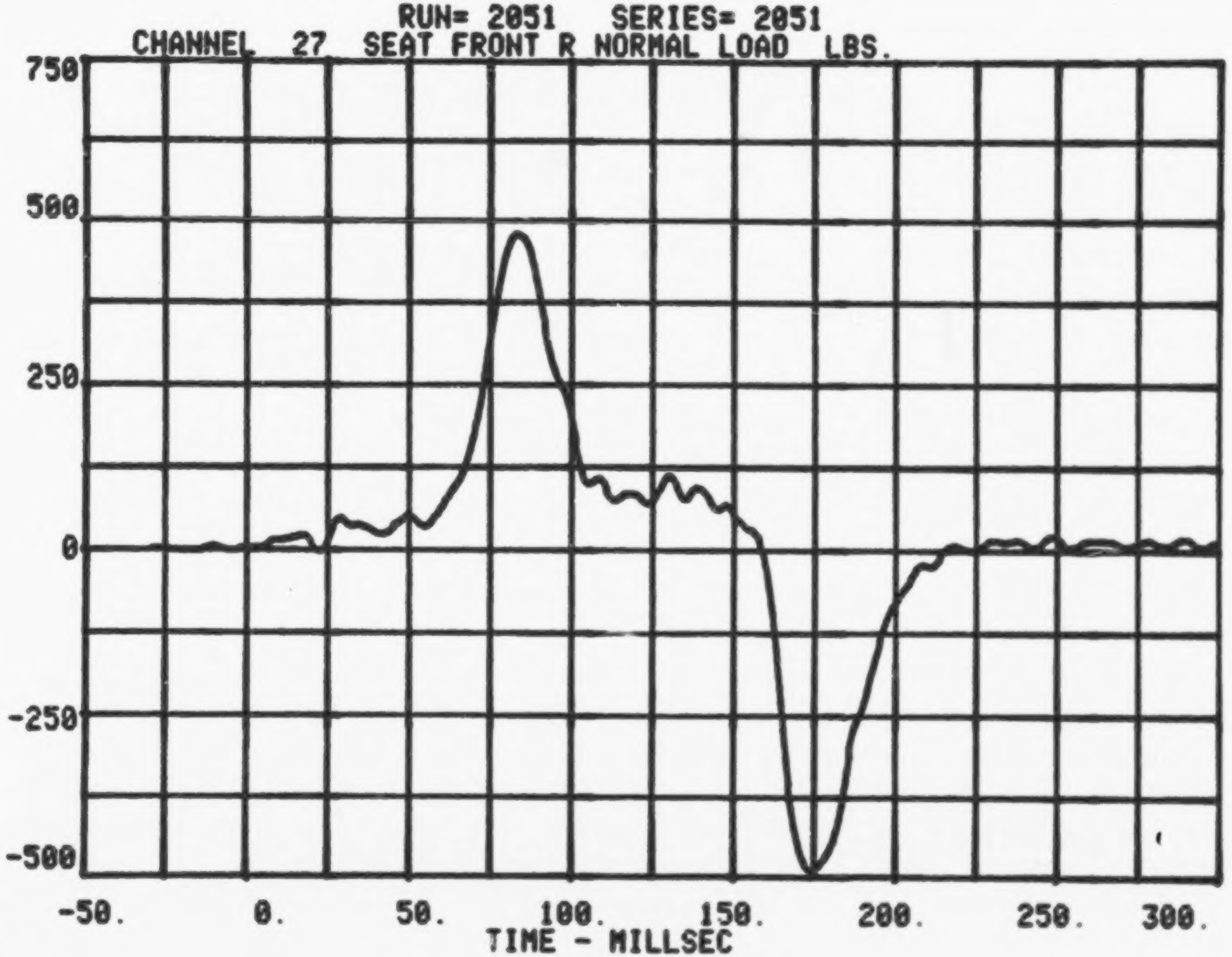
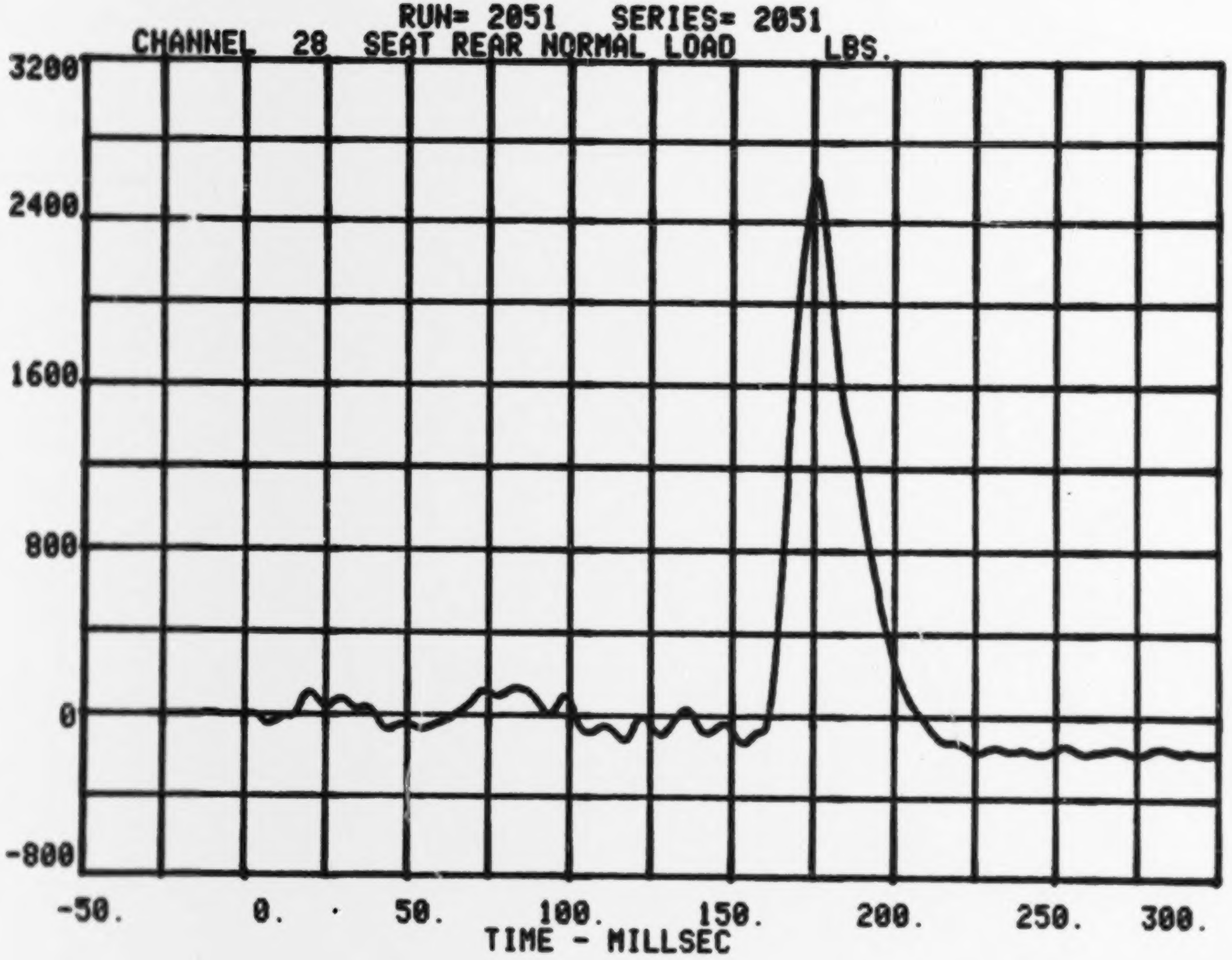
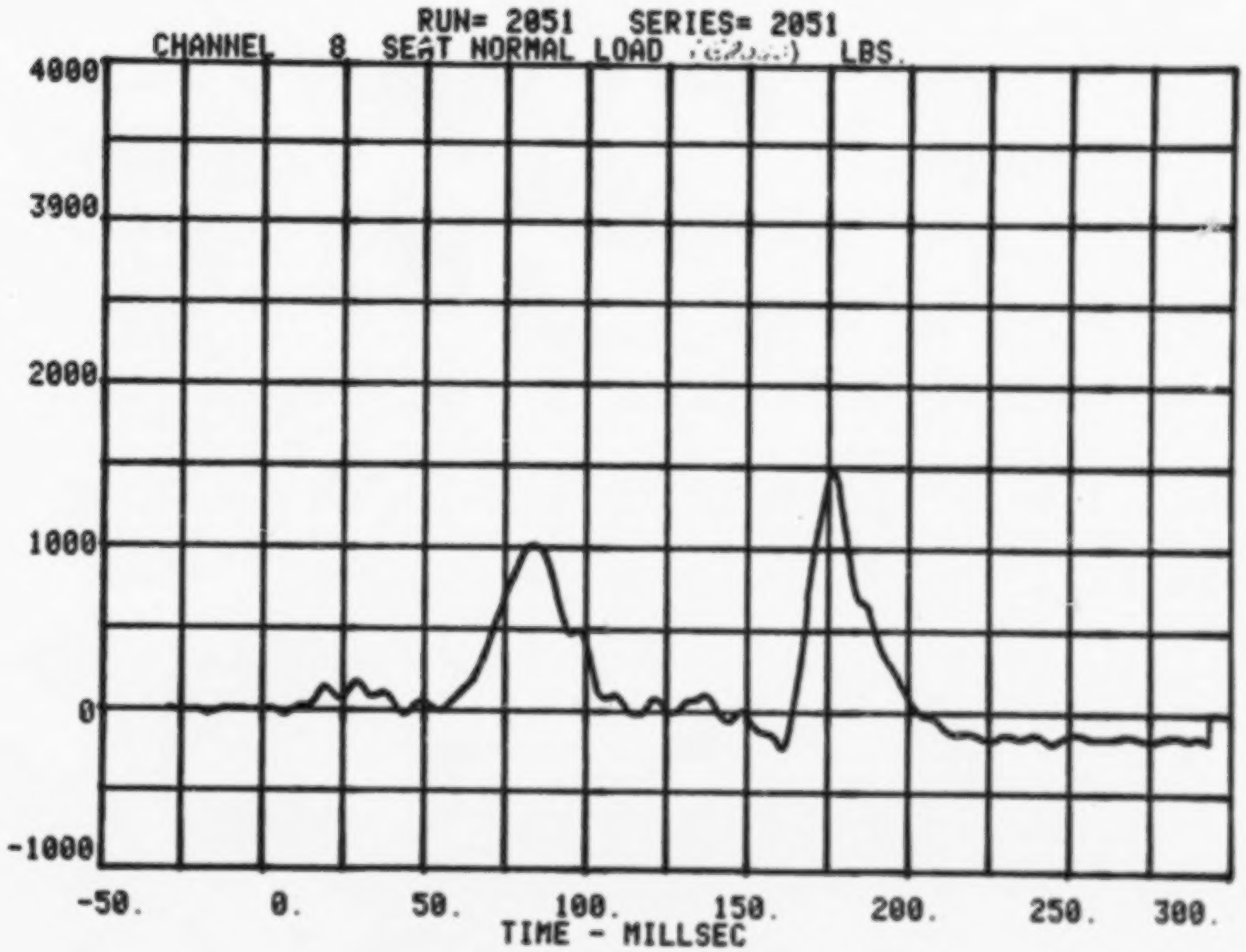


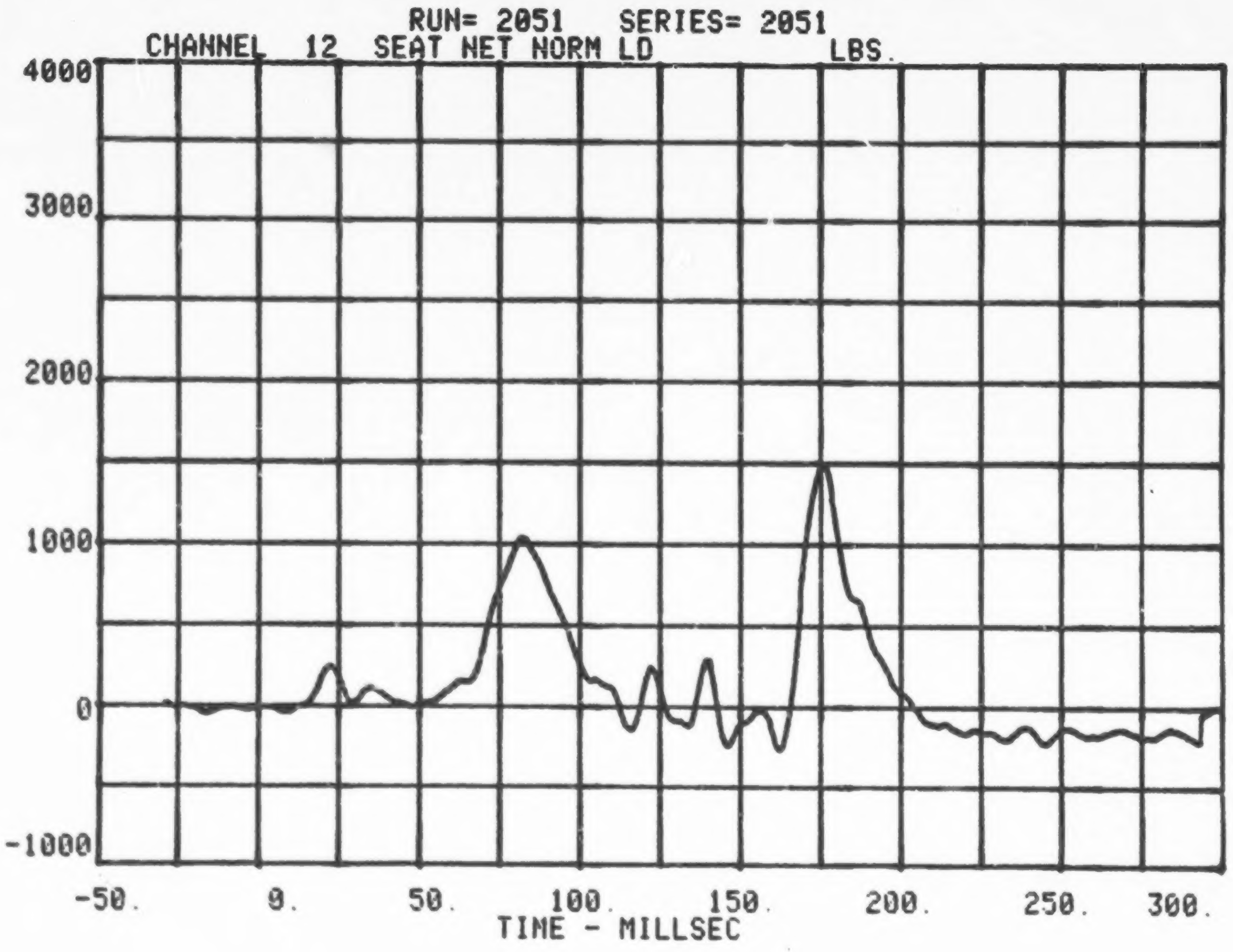

RUN= 2051 SERIES= 2051
CHANNEL 27 SEAT FRONT R NORMAL LOAD LBS.
750
500
250
0
-250
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

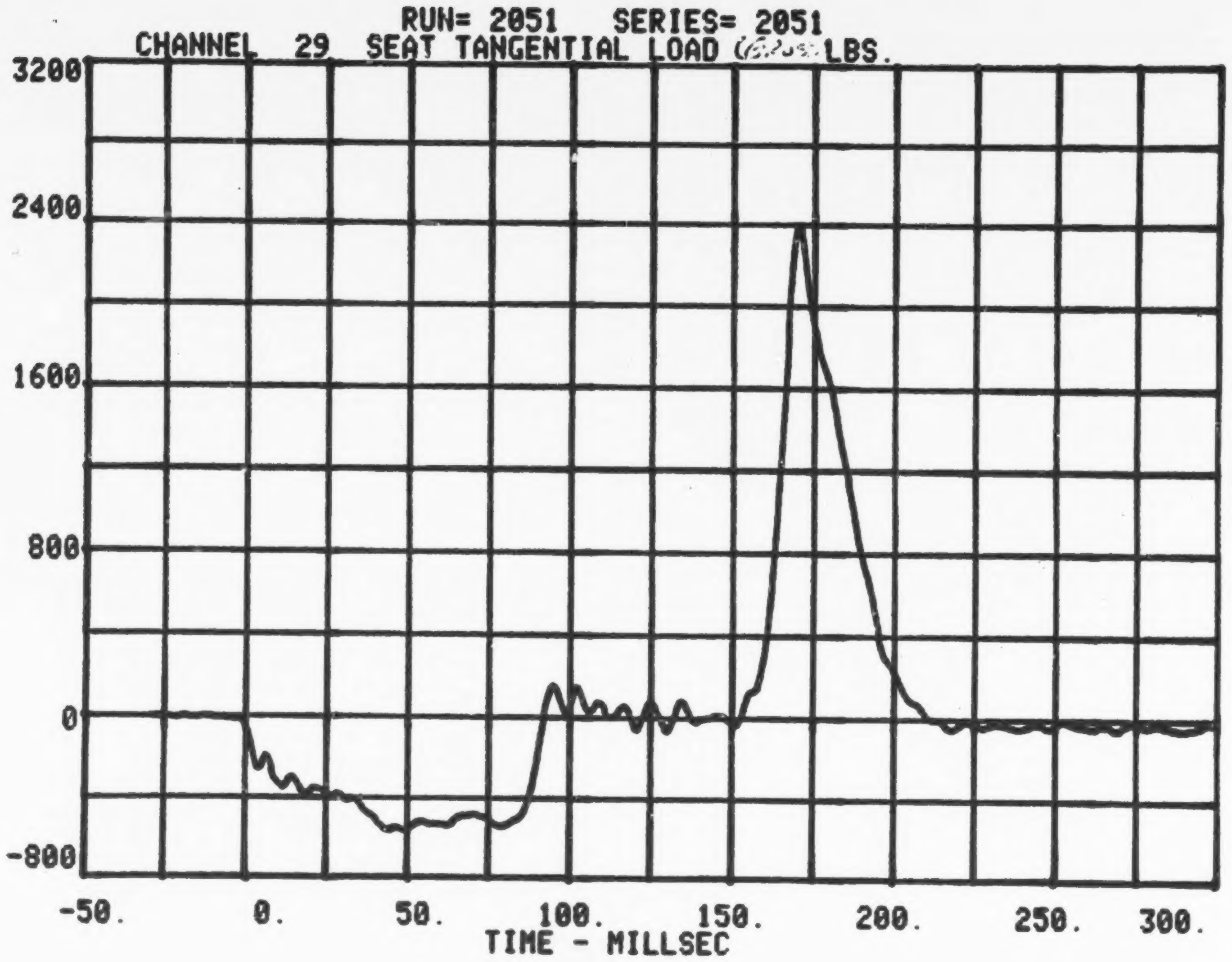
BEST DOCUMENT AVAILABLE

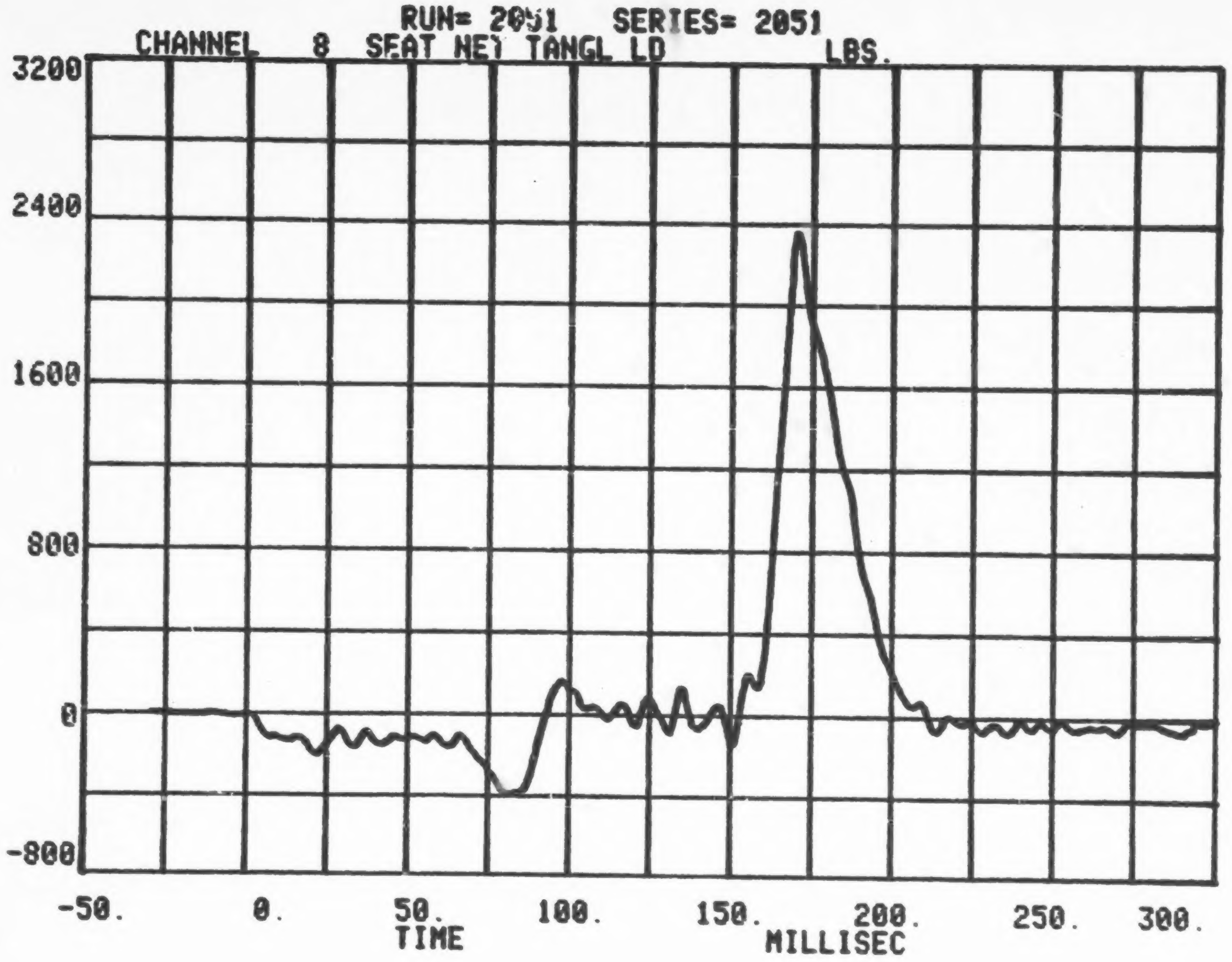


RUN= 2051 SERIES= 2051
CHANNEL 28 SEAT REAR NORMAL LOAD LBS.

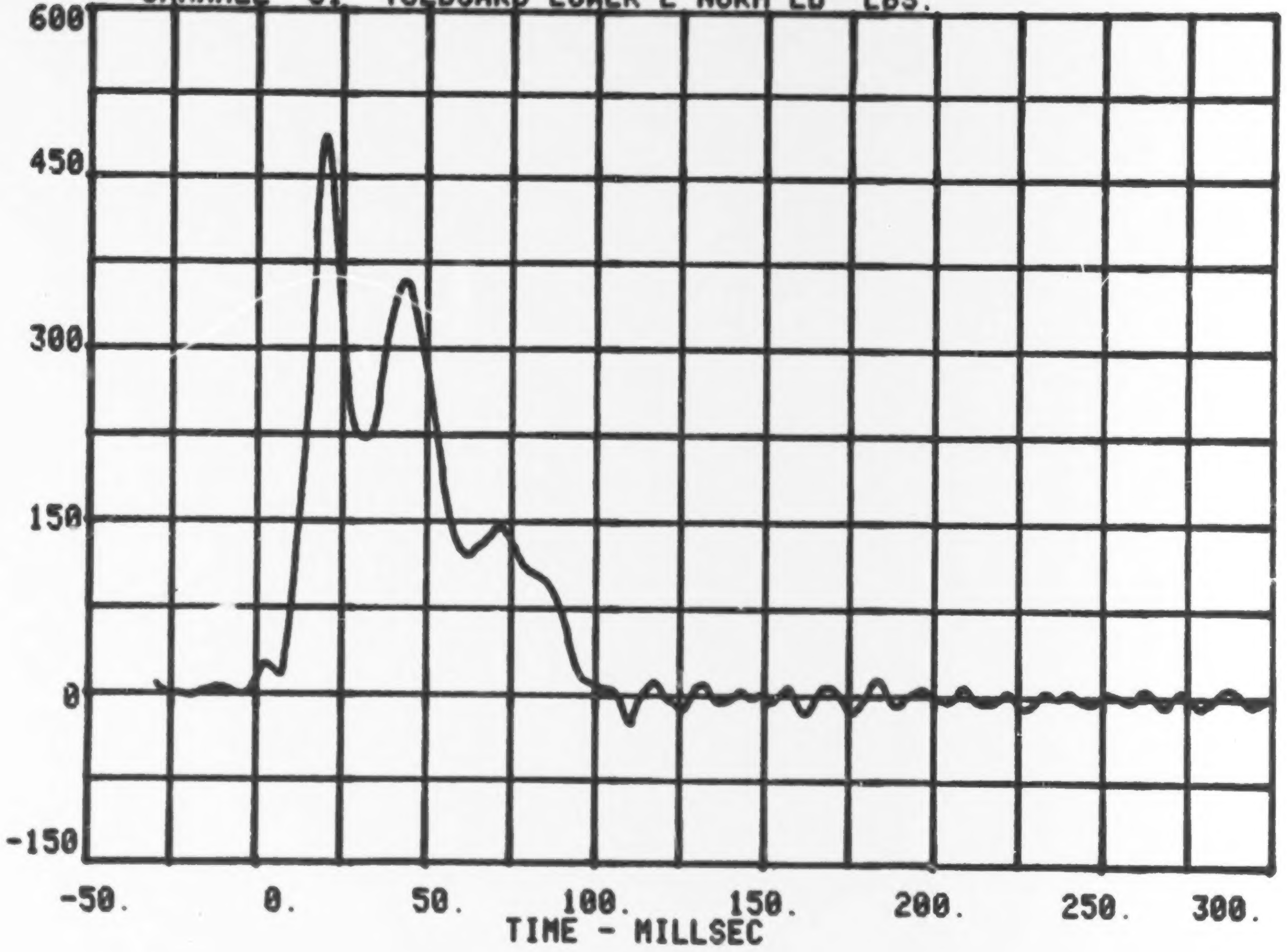

RUN= 2051 SERIES= 2051
CHANNEL 8 SEAT NORMAL LOAD) LBS.
4000
3900
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051
CHANNEL 12 SEAT NET NORM LD LBS.
4000
3000
2000
1000
0
-1000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

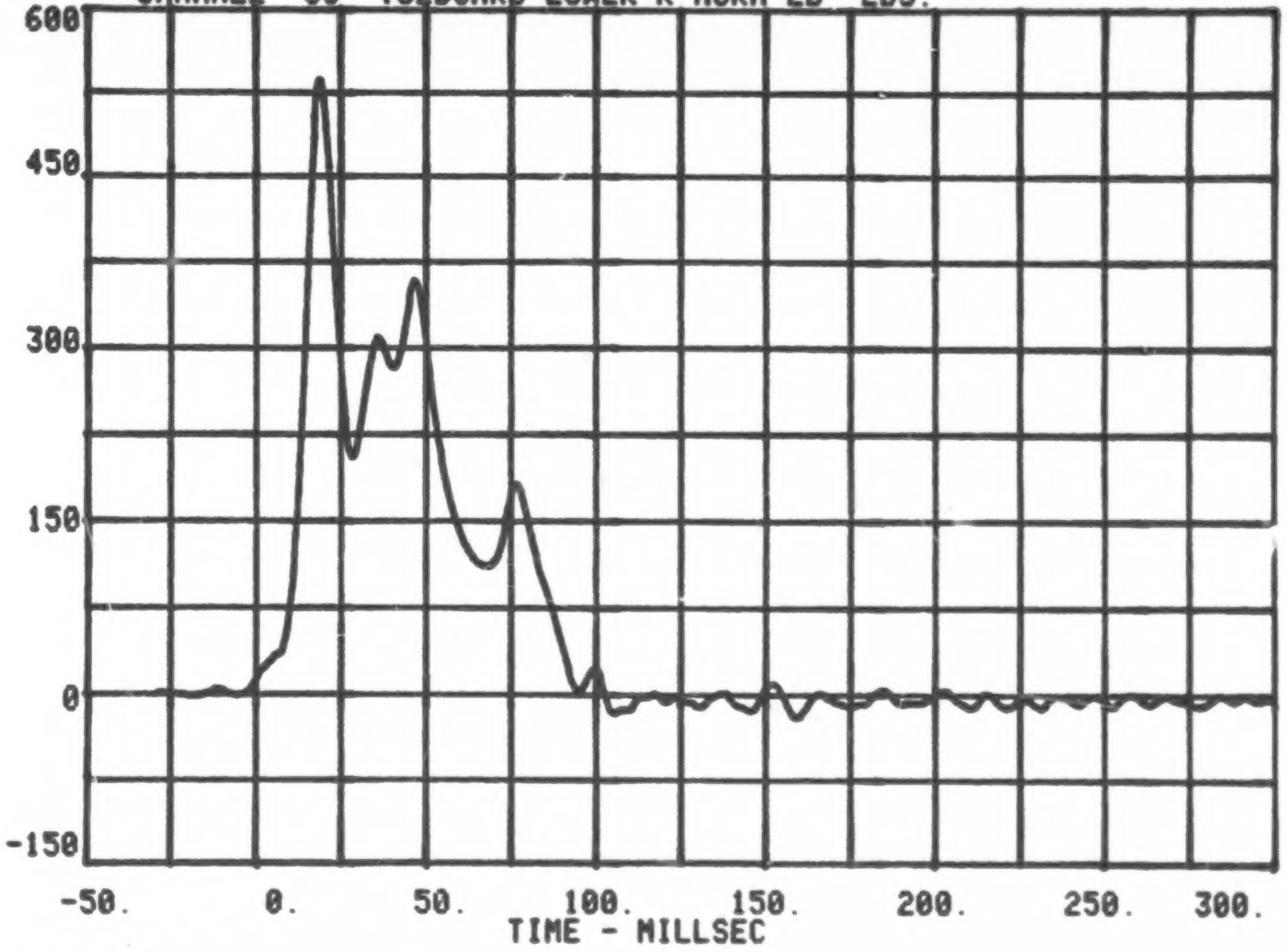

RUN= 2051 SERIES= 2051
CHANNEL 29 SEAT TANGENTIAL LOAD [illegible] LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051
CHANNEL 8 SEAT NET TANGL LD LBS.
3200
2400
1600
800
0
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

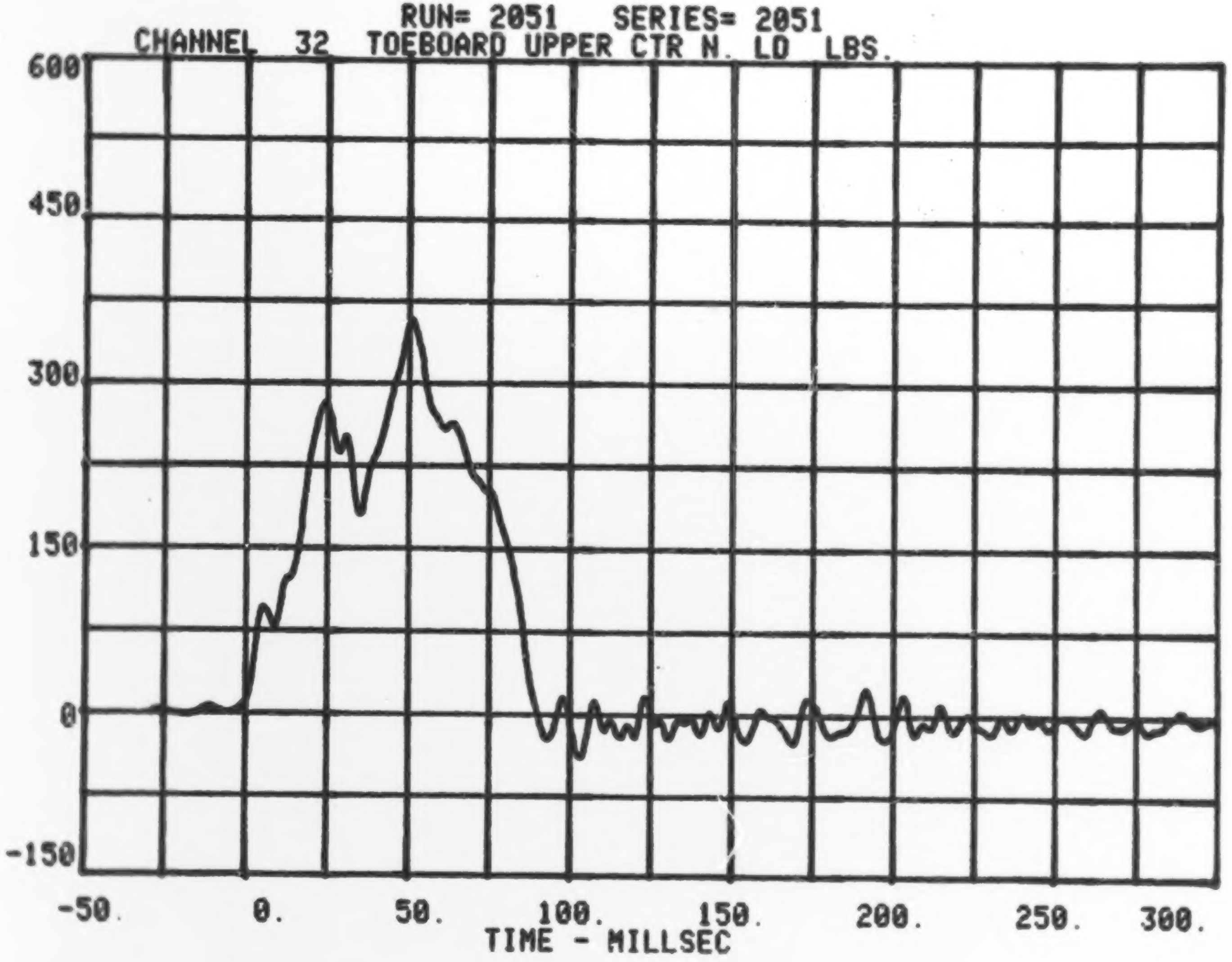
RUN= 2051 SERIES= 2051
CHANNEL 31 TOEBOARD LOWER L NORM LD LBS.

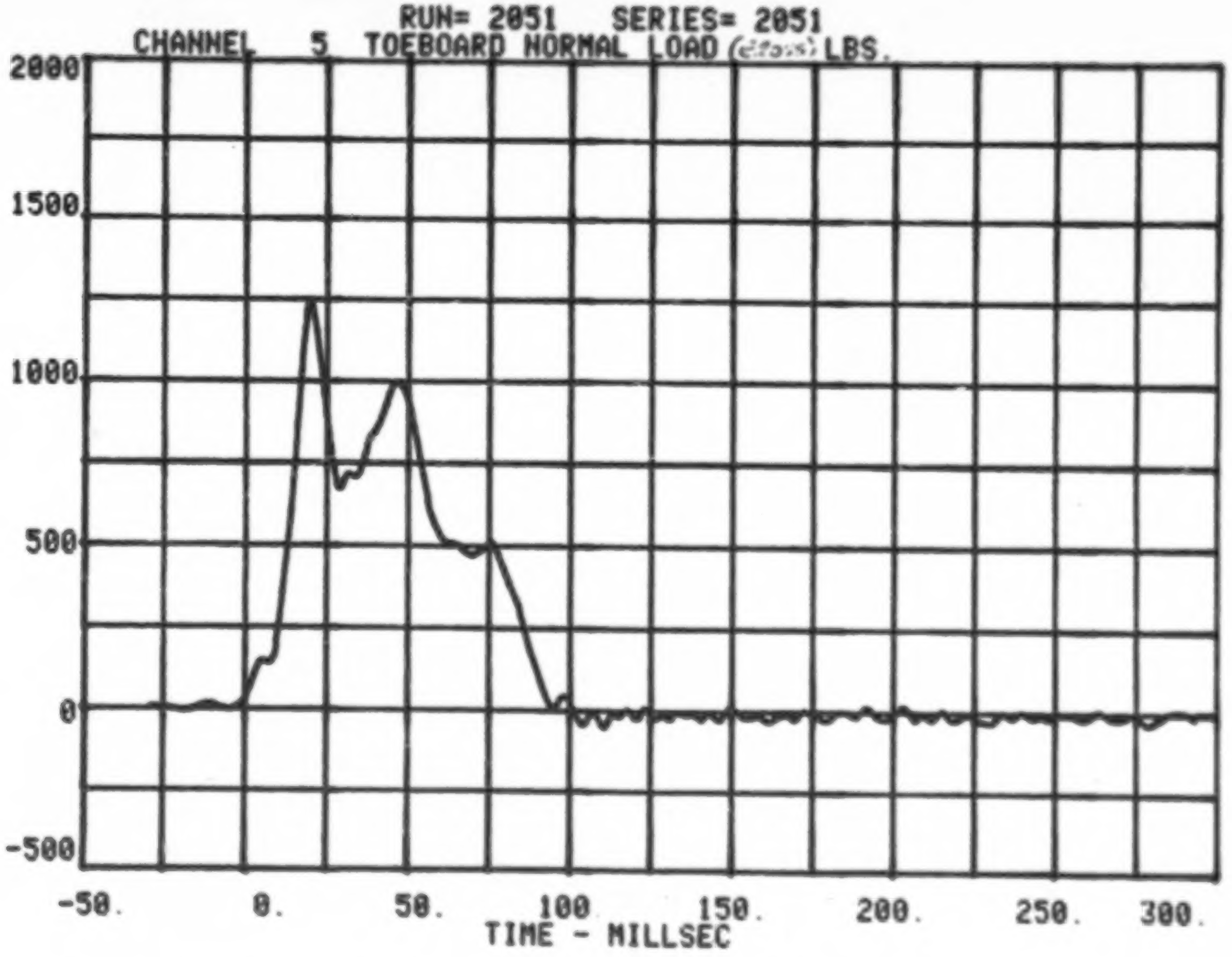


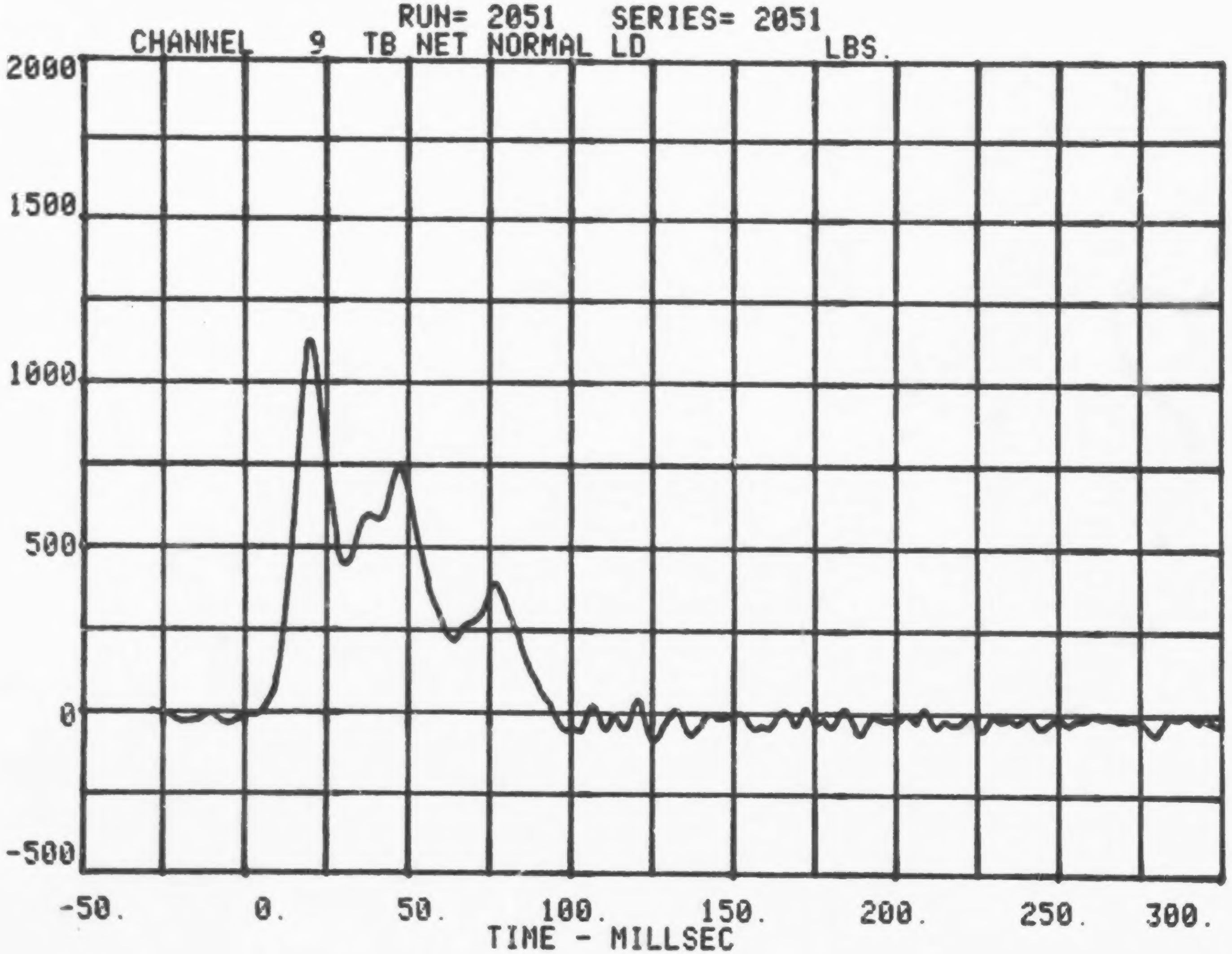
RUN= 2051 SERIES= 2051
CHANNEL 30 TOEBOARD LOWER R NORM LD LBS.



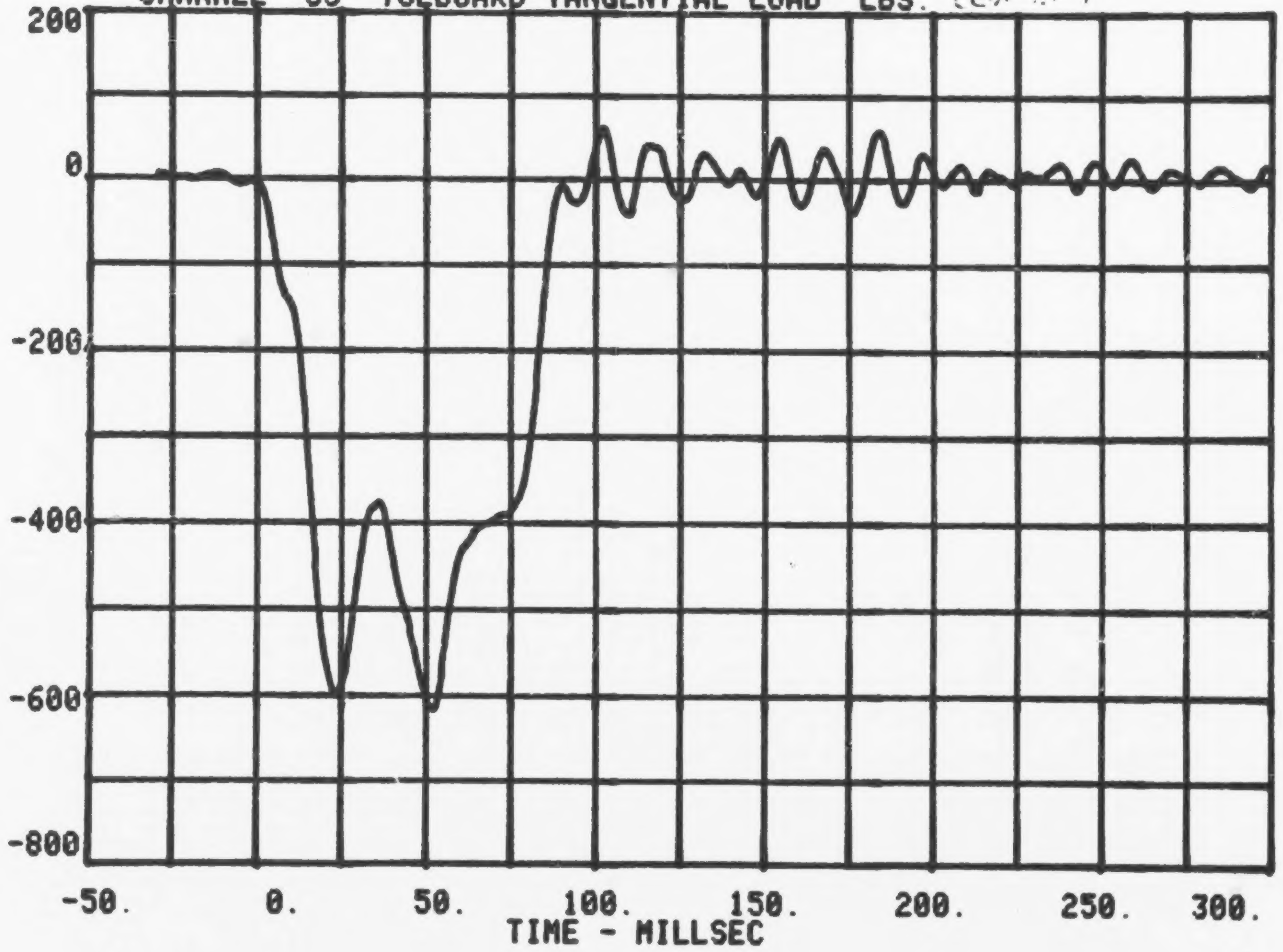
BEST DOCUMENT AVAILABLE

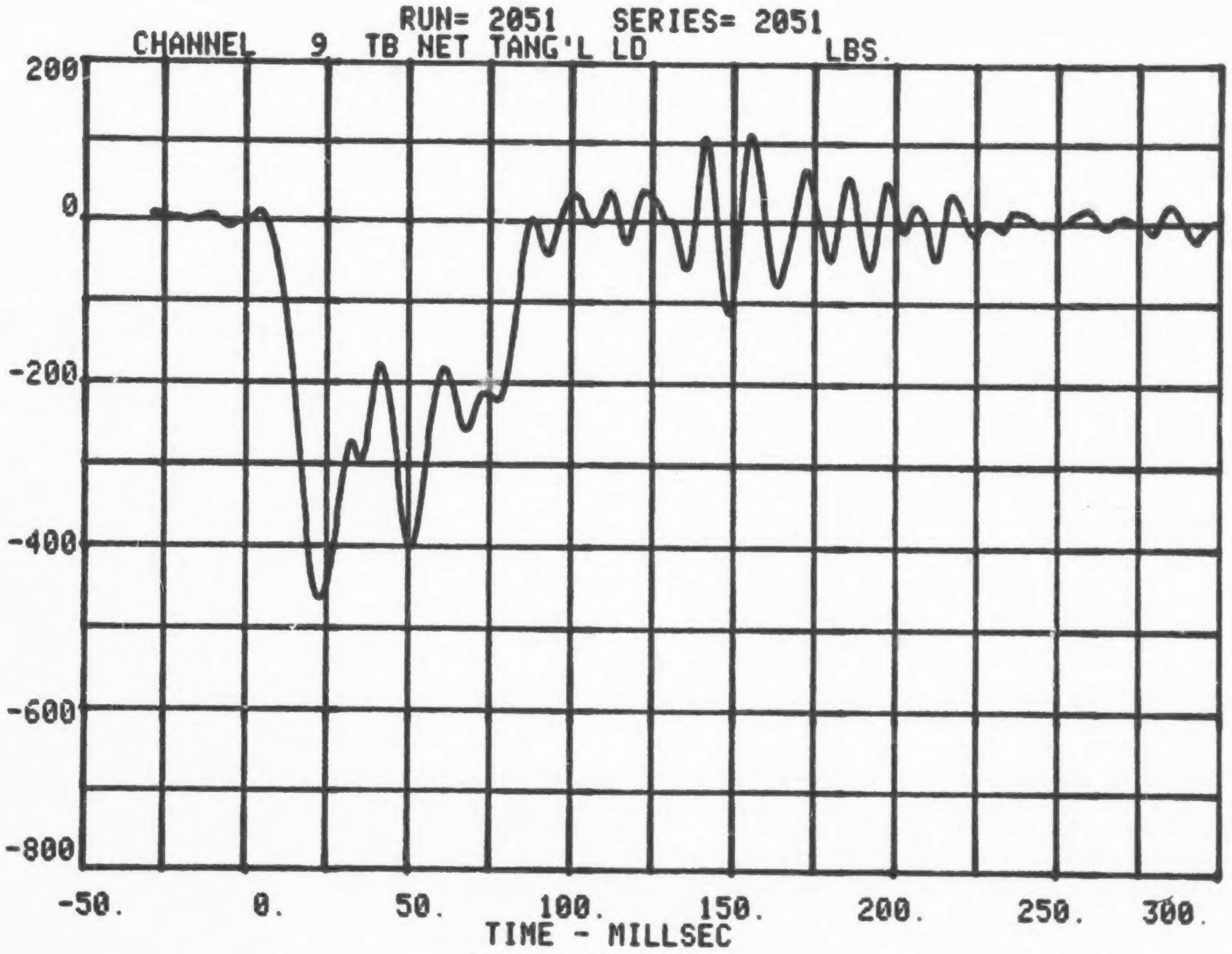



RUN= 2051 SERIES= 2051
CHANNEL 5 TOEBOARD NORMAL LOAD ([illegible]) LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100
150.
200.
250.
300.
TIME - MILLSEC

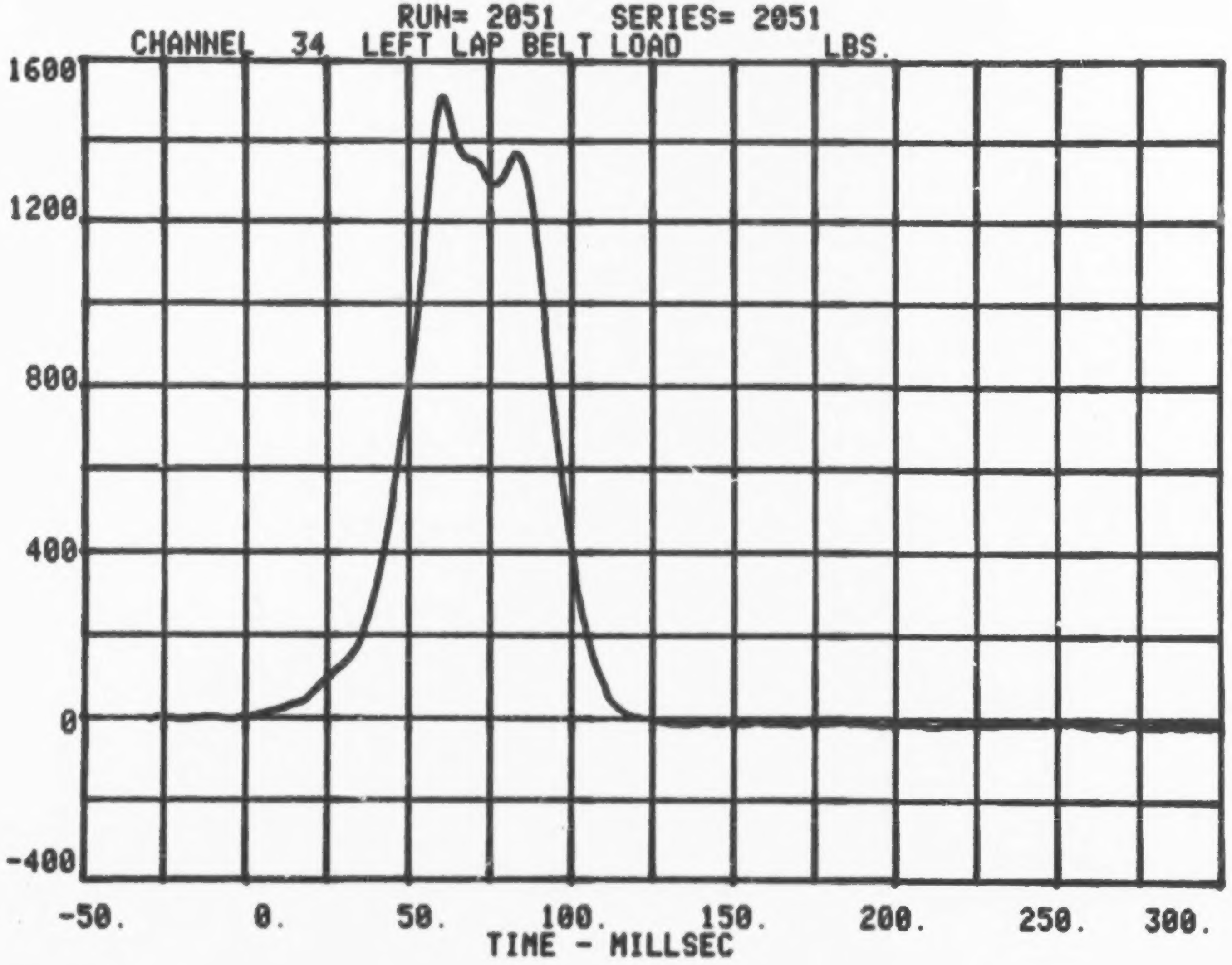

RUN= 2051 SERIES= 2051
CHANNEL 9 TB NET NORMAL LD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

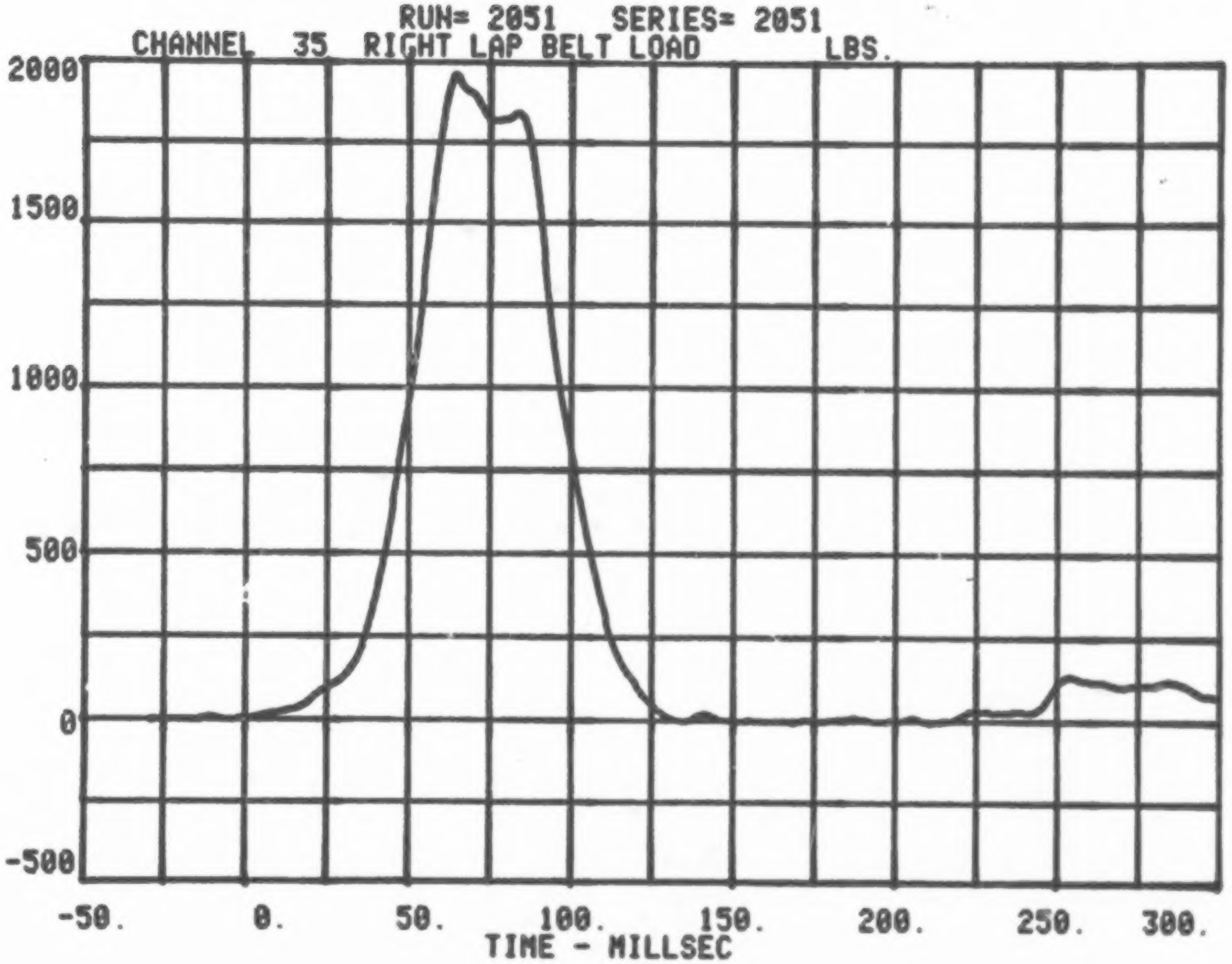
RUN= 2051 SERIES= 2051
CHANNEL 33 TOEBOARD TANGENTIAL LOAD LBS. (G[illegible])

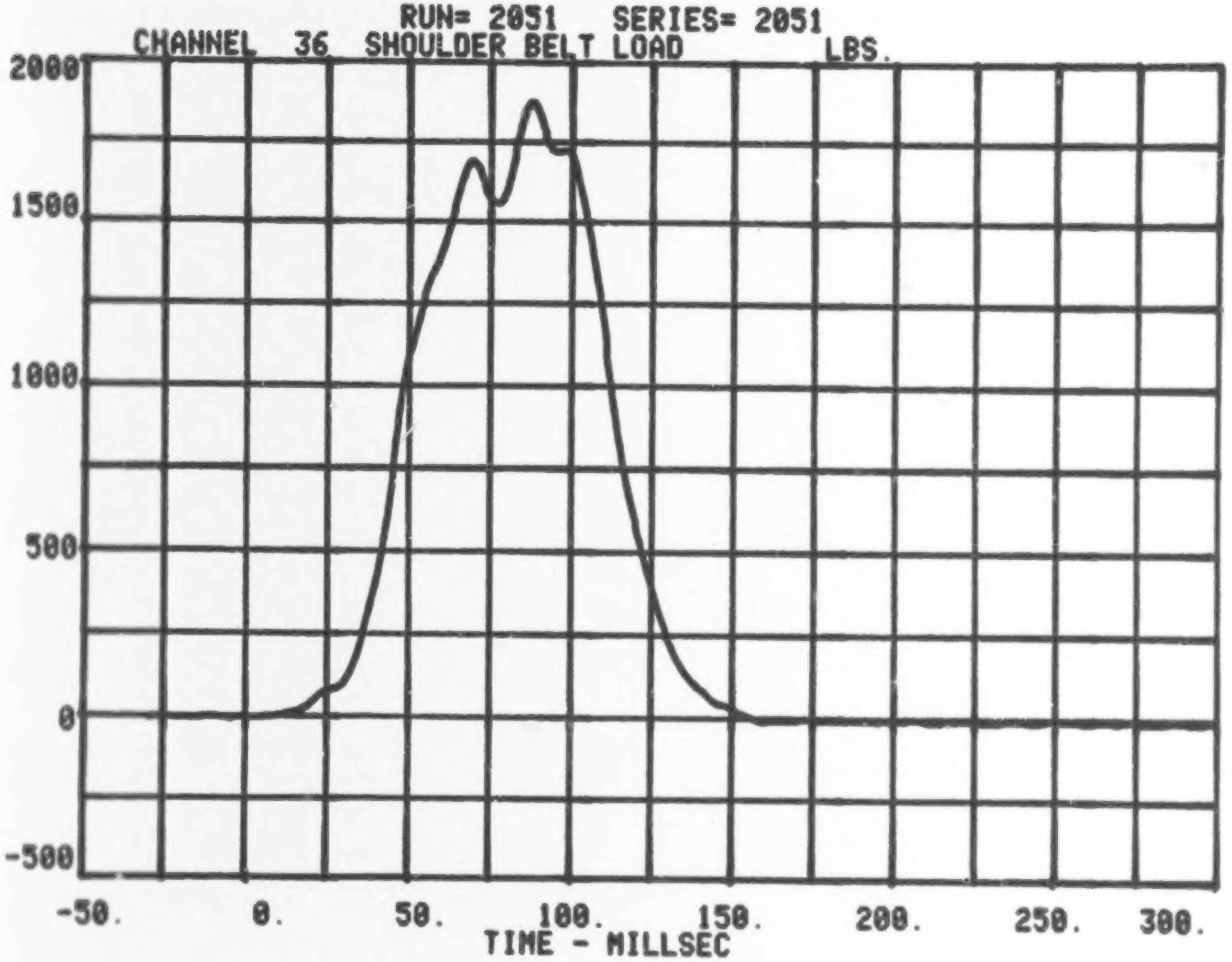


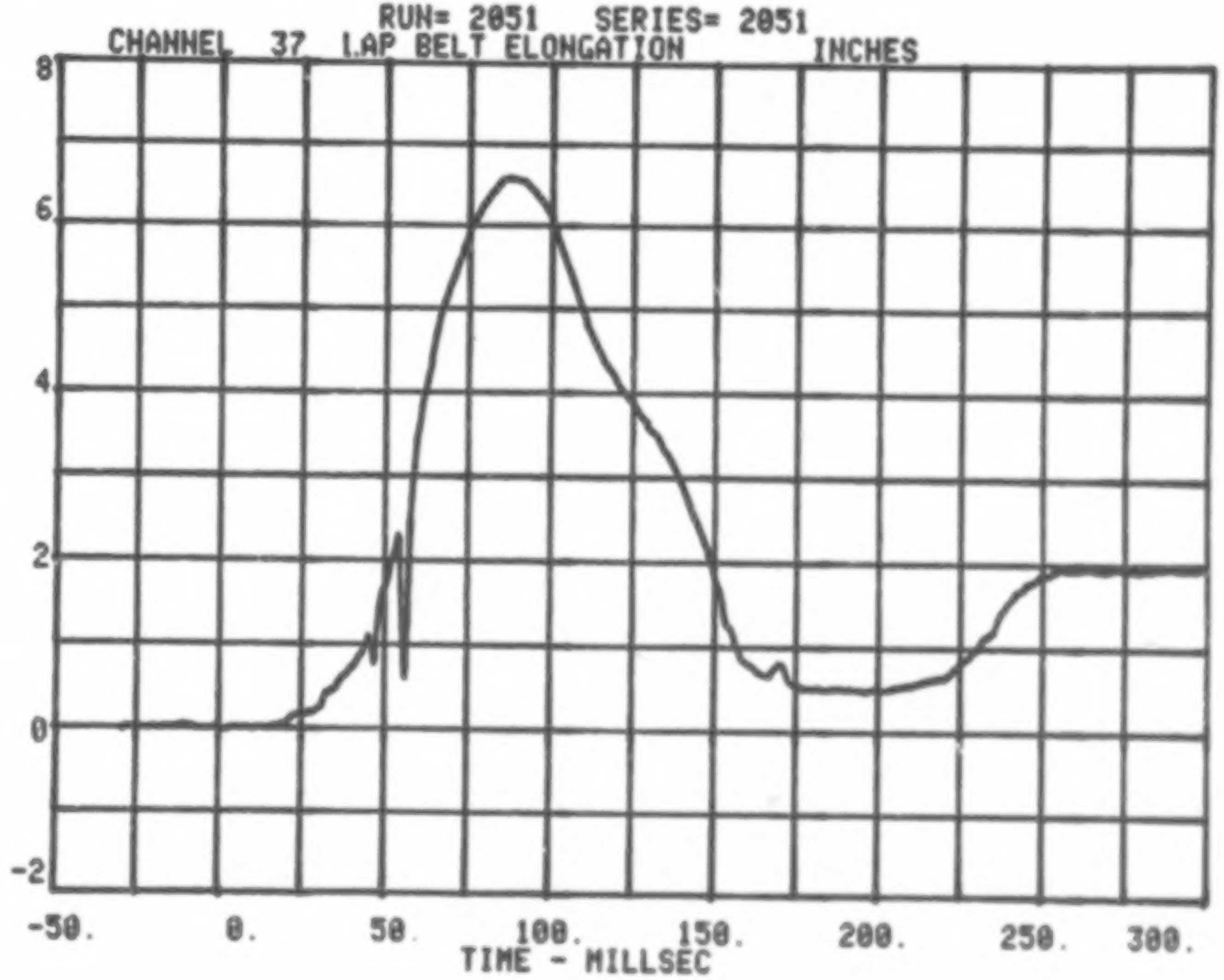

RUN= 2051 SERIES= 2051
CHANNEL 9 TB NET TANG'L LD LBS.
200
0
-200
-400
-600
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

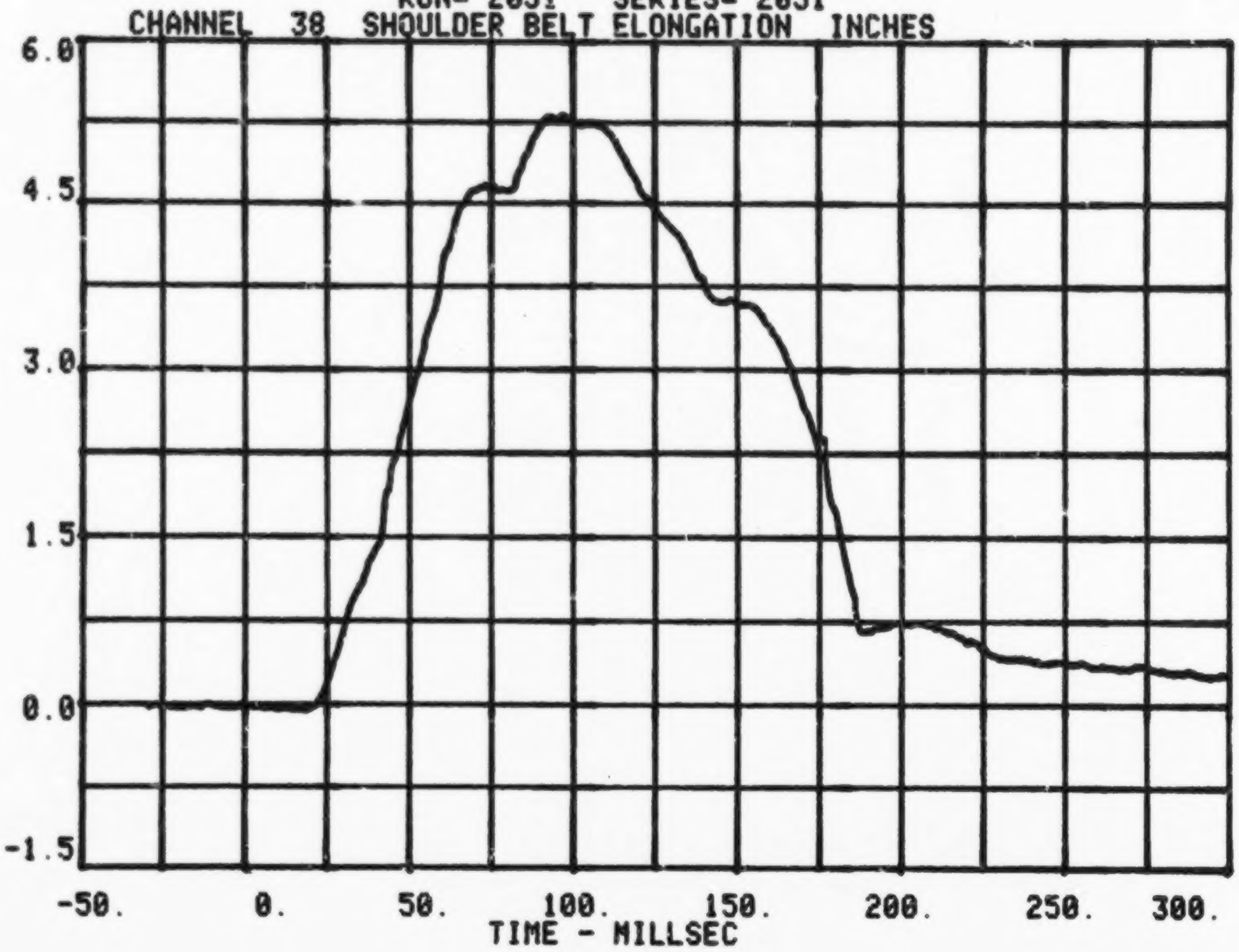
BEST DOCUMENT AVAILABLE

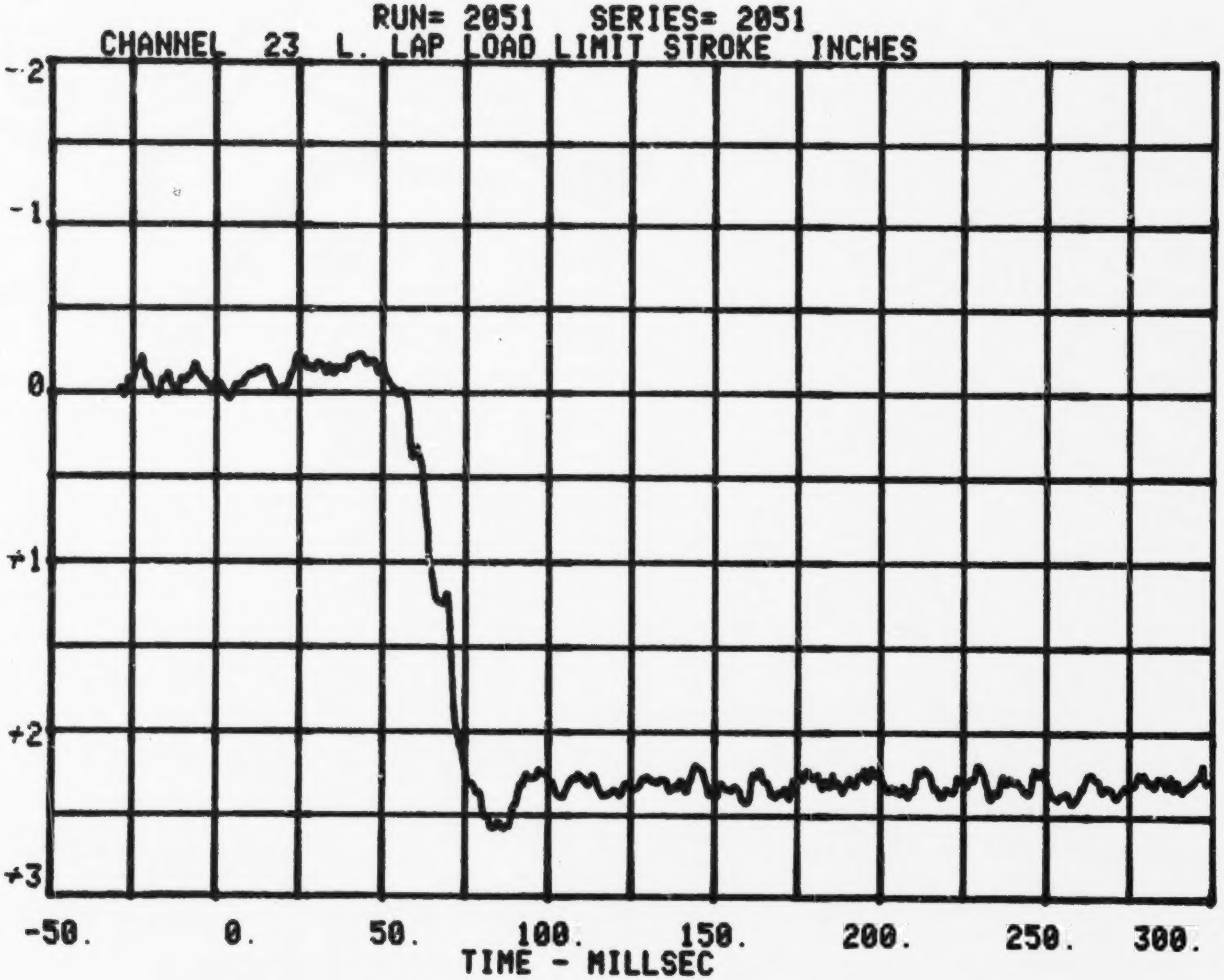



RUN= 2051 SERIES= 2051
CHANNEL 35 RIGHT LAP BELT LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

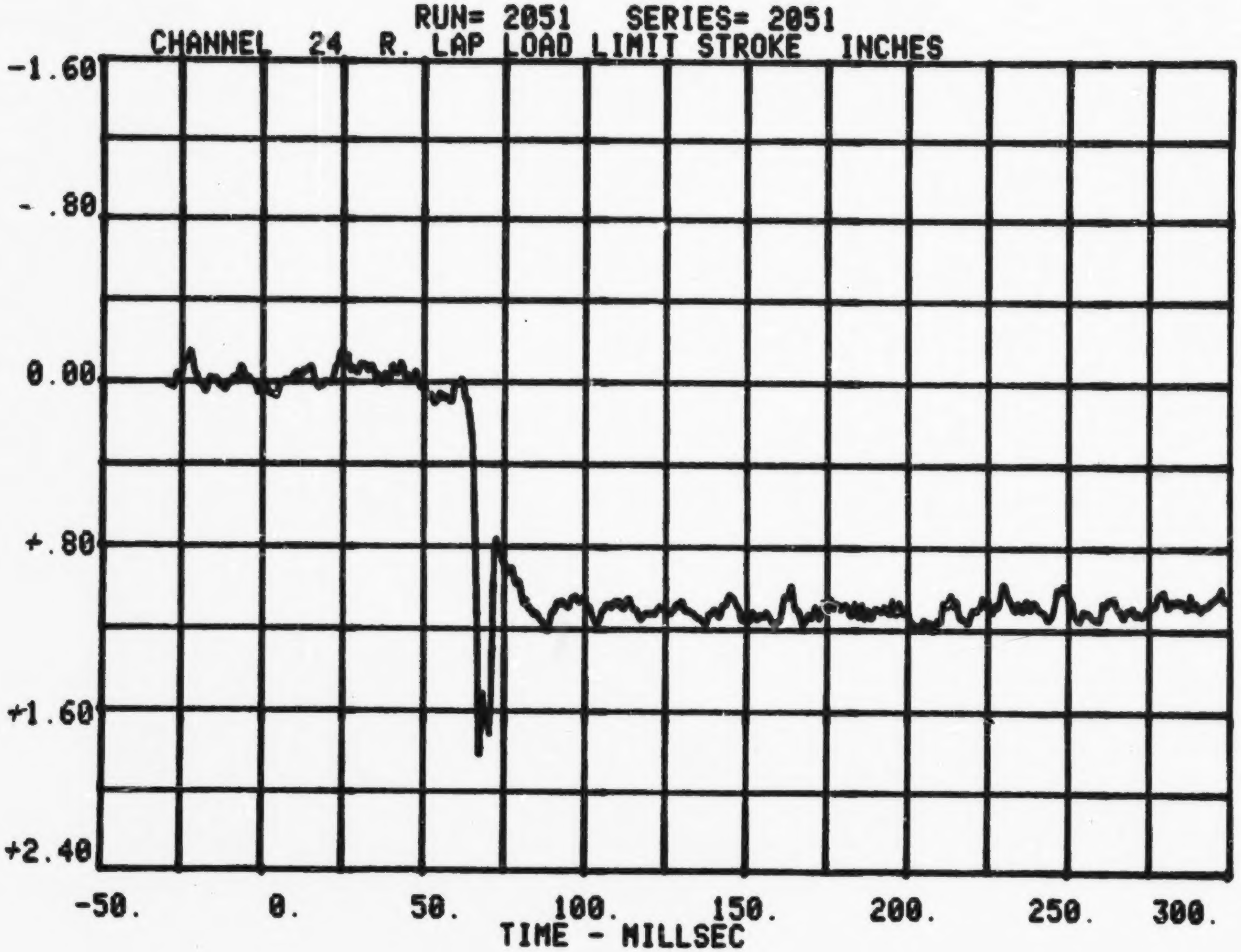

RUN= 2051 SERIES= 2051
CHANNEL 36 SHOULDER BELT LOAD LBS.
2000
1500
1000
500
0
-500
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC


RUN= 2051 SERIES= 2051
CHANNEL 37 LAP BELT ELONGATION INCHES

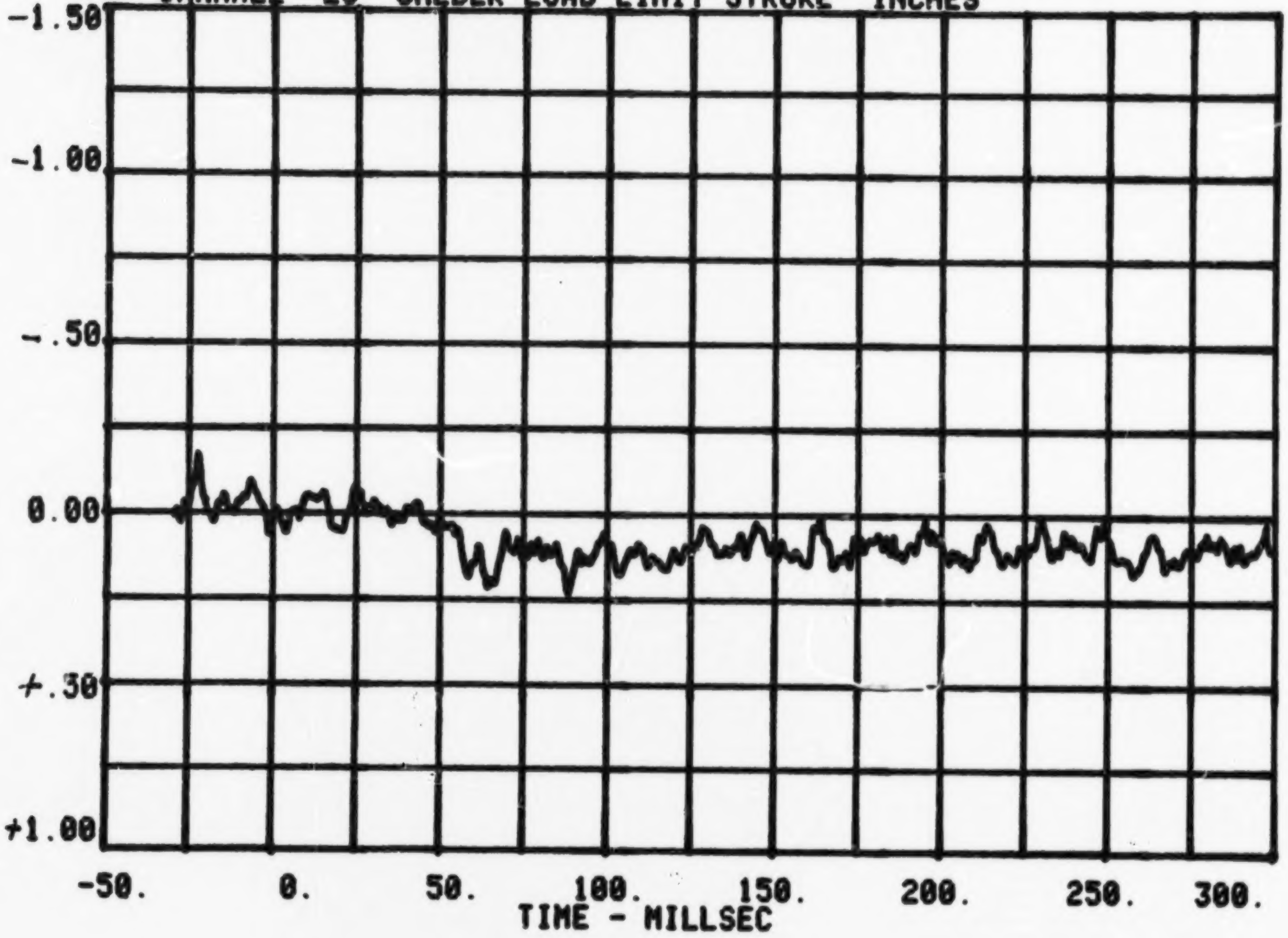

RUN= 2051 SERIES= 2051
CHANNEL 38 SHOULDER BELT ELONGATION INCHES
6.0
4.5
3.0
1.5
0.0
-1.5
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

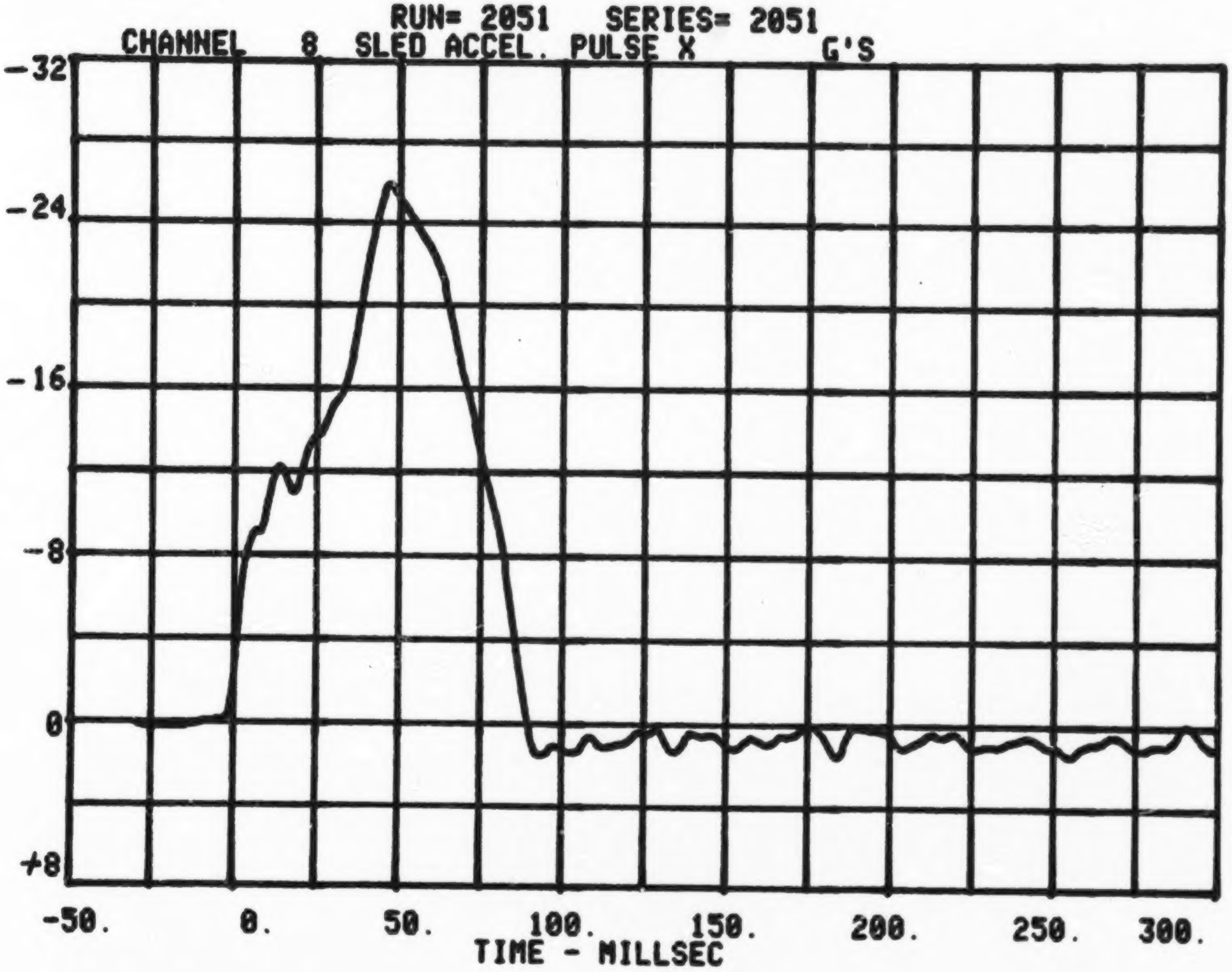

RUN= 2051 SERIES= 2051
CHANNEL 23 L. LAP LOAD LIMIT STROKE INCHES
-2
-1
0
+1
+2
+3
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC

BEST DOCUMENT AVAILABLE



RUN= 2051 SERIES= 2051
CHANNEL 25 SHLDER LOAD LIMIT STROKE INCHES




RUN= 2051 SERIES= 2051
CHANNEL 8 SLED ACCEL. PULSE X G'S
-32
-24
-16
-8
0
+8
-50.
0.
50.
100.
150.
200.
250.
300.
TIME - MILLSEC